TRANSACTIONS
OF THE
ROYAL SOCIETY OF NEW ZEALAND

ZOOLOGY

VOL. 3 NO. 6 FEBRUARY 11, 1963

A Revision of the New Zealand and Subantarctic Athoracophoridae

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[*Received by the Editor, July 3, 1962.*]

Abstract

A systematic account of the Athoracophoridae of New Zealand and the subantarctic islands is given, together with diagnoses of the family and genera. The account is based on the study of a total of 241 specimens, which comprise four genera, including *Reflectopallium* n. gen. and *Palliopodex* n. gen., and twenty-two species, including *Pseudaneitea maculata, P. gravisculca, P. campbellensis, P. powelli, P. multistriata, P. johnsi, P. aspera, Athoracophorus maculosus, Reflectopallium pseudophyllum, R. papillatum,* and *R. delli,* n. sp. The genus *Amphiconophora* Suter, 1897, is reduced to synonymy with *Pseudaneitea* Cockerell, 1891, and the genus *Vomanus* Iredale, 1915, is reduced to synonymy with *Athoracophorus* Gould, 1852. The subspecies *Athoracophorus bitentaculatus rufovenosus* Suter, 1909, is synonymised with *Athoracophorus bitentaculatus* (Quoy and Gaimard, 1832). The distribution of members of the group in New Zealand and the subantarctic islands is discussed, as also is the ultimate derivation of the group.

INTRODUCTION

SINCE the publication of Suter's "Manual of the New Zealand Mollusca" in 1913, the Athoracophoridae of New Zealand and the subantarctic islands have been neglected, apart from the description of one new species by Powell in 1955. However, extensive collecting has been carried out over the last fifteen years, and many specimens from areas not previously covered are available for study.

The New Zealand and subantarctic slugs are superficially diverse, but show no great diversity in anatomy. The most distinctive character of the family is the possession of a dorsal tracheate lung, consisting of a pulmonary cavity from the floor of which thin-walled pulmonary diverticula radiate to form the roof of a dorsal blood sinus. Thiele (1931, 1935) groups all pulmonates with this feature into one superfamily, the Tracheopulmonata. This group has representatives in the Admiralty Islands, New Britain, New Hebrides, New Caledonia, and on the eastern coast of Australia.

Much confusion has arisen in the past through inaccurate observation and description, and reliance on colour as a systematic criterion. Some species, apparently erected on the basis of colour alone, have later had to be grouped together under one specific name.

Published by the Royal Society of New Zealand, c/o Victoria University of Wellington, P.O. Box 196, Wellington.

More extensive collecting in many areas is still necessary. As the group displays marked geographic speciation, it is probable that more new species still exist in a number of seldom visited places.

Type specimens have been deposited in the Dominion Museum, Wellington.

Historical Note

Between January 10 and March 18, 1827, J. R. C. Quoy and J. P. Gaimard visited New Zealand on the 'Astrolabe', and became the first to describe Athoracophoridae from this country. Included in their descriptions was one of *Limace tentaculee*. Gray, in 1850, made the next contribution, when he erected a new genus, *Janella*, to accommodate this species. He apparently did not realise that this name had already been used by Grateloup in 1838. In the meantime, the first United States Exploring Expedition had visited New Zealand in 1840, and had collected more material. Unfortunately this was not described until 1852, when Gould published an account, using the generic name *Athoracophorus* instead of *Janella*. The earlier publication of Gray's invalid *Janella* caused a considerable amount of confusion over the next fifty years.

Gray, in 1853, described a further species which he called *Janella antipodarum*. This was later included in *Athoracophorus bitentaculatus* by Suter, who regarded it as a variety of this species. Gray was apparently led astray by the wide variation in colour pattern found in *Athoracophorus bitentaculatus*: during the early study of the group, much importance was placed on colour as a diagnostic character, and the importance of the study of lateral grooves was not appreciated.

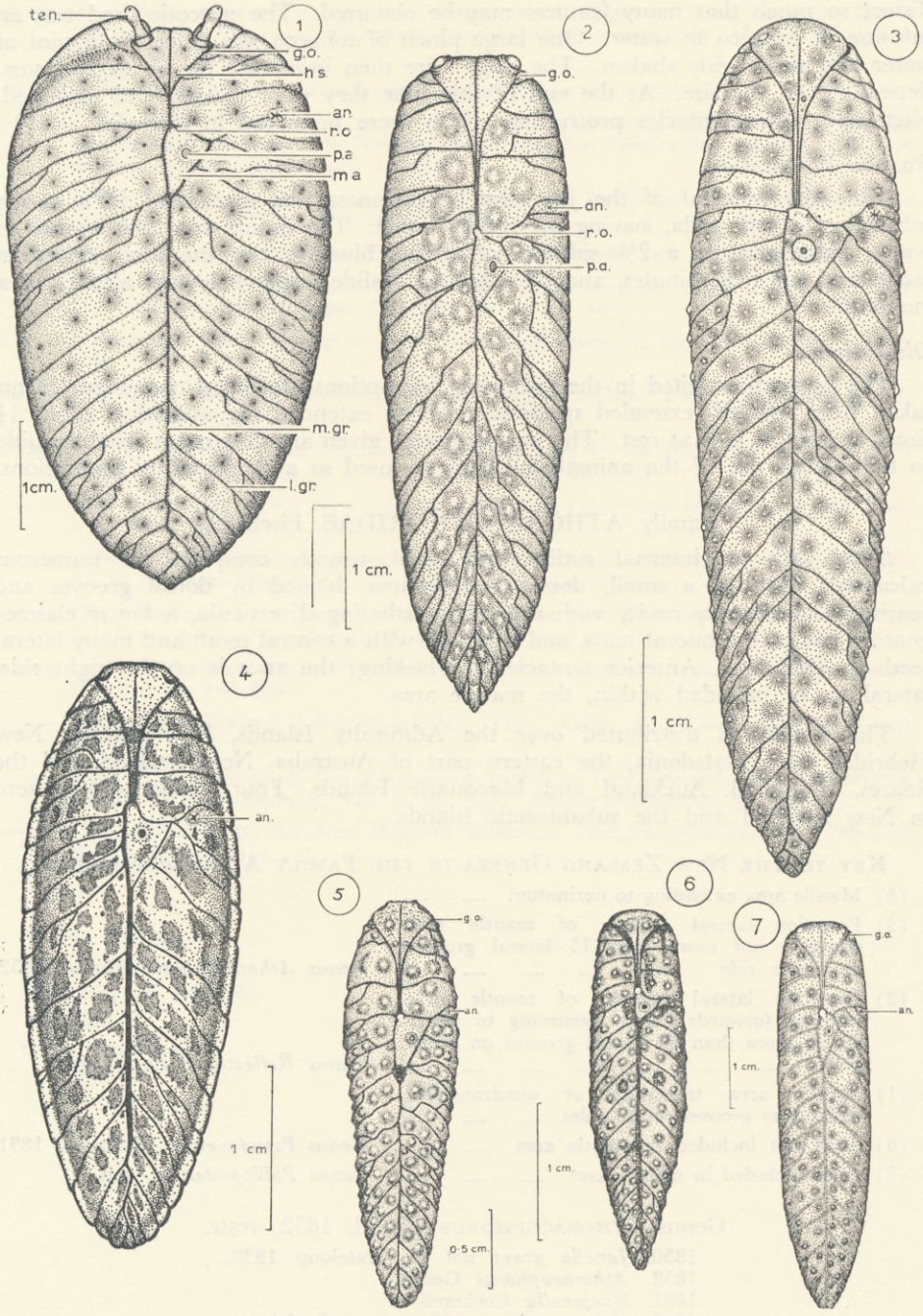
Then, with Hutton's descriptions in 1878, a period of about thirty years commenced during which a considerable amount of work was done on the group. It is unfortunate that Hutton's descriptions are useless from a taxonomic point of view: his *Konophora marmorea*, 1878, is quite unrecognisable. However, other workers soon entered the field. The first was Simroth, 1889, who described *Athoracophorus verrucosus* from the Auckland Islands.

In 1891, the process of splitting up the genus commenced when Cockerell erected a new subgenus *Pseudaneitea* to include Hutton's *Athoracophorus papillatus*. During the next six years various checklists and summaries of the group were published by Hedley and Suter, but little more was done until Suter described two new species, *Athoracophorus (Pseudaneitea) dendyi* and *Athoracophorus (Pseudaneitea) simrothi*, in 1897. Ludwig Plate described another new species, which he called *Janella schauinslandi*, in the same year. After this, the only worker on the group over the next forty years was Suter. In 1909 he described three new species, *Athoracophorus (Pseudaneitea) huttoni, Athoracophorus (Pseudaneitea) martensi*, and *Athoracophorus (Amphiconophora) gigantea*, as well as a subspecies, *Athoracophorus bitentaculatus rufovenosus*. Thus in 1913, when Suter published his 'Manual of the New Zealand Mollusca', the group comprised four subgenera, containing ten species and one subspecies. Apart from a nomenclatural change by Iredale in 1915, no further work was done until 1937, when Powell elevated all the subgenera to genera. No comment was made on this step, but as the genera are easily recognisable and anatomically distinct there is no doubt that it was justifiable. In 1955, Powell described one more species, *Pseudaneitea sorenseni*, from Campbell Island.

Materials and Methods

Preparation and Preservation.

Specimens must be carefully narcotised before preservation, otherwise the buccal mass will protrude through the mouth, and the animal will contract and



TEXT-FIG. 1

FIG. 1.—*Pseudaneitea papillata.* FIG. 2.—*P. dendyi.* FIG. 3.—*P. multistriata.* FIG. 4.—*P. gigantea.* FIG. 5.—*P. johnsi.* FIG. 6.—*P. sorenseni.* FIG. 7.—*P. schauinslandi.*
An., anus; g.o., genital orifice; h.s., head shield; l.gr., lateral groove; m.a., mantle area; m.gr., median groove; p.a., pulmonary aperture; r.o., renal orifice.

distort so much that many features may be obscured. The narcotic used was an infusion of tobacco in water. One large pinch of tobacco was placed in a pint of water and thoroughly shaken. The slugs were then immersed for up to 36 hours, depending on the size. At the end of this time they were relaxed and extended, often with their tentacles protruding. They were preserved in formalin.

Radula Preparation.

After the removal of the jaw, the buccal mass was macerated in a strong solution of caustic soda, leaving the radula intact. The radula was then washed in water, transferred to a 2% solution of aniline blue for two minutes, washed in lactic acid for five minutes, and mounted on a slide, using polyvinyl alcohol as a mountant.

Dimensions.

The proportions cited in the following descriptions are based on measurements taken from relaxed, extended specimens. When extended the animal is about 1½ times as long as it is at rest. The measurements given are thus not a reliable guide to the overall size of the animal, but may be used as a guide to its proportions.

Family ATHORACOPHORIDAE Fischer.

Slugs with an internal rudimentary shell, usually composed of numerous calcareous deposits, a small, dorsal mantle area defined by dorsal grooves and bearing a pulmonary cavity with numerous radiating diverticula, a horny elasmognathic jaw in the buccal mass, and a radula with a central tooth and many lateral teeth in each row. Anterior tentacles are lacking; the anus is on the right side, lateral to, or included within, the mantle area.

The Family is distributed over the Admiralty Islands, New Britain, New Hebrides, New Caledonia, the eastern part of Australia, New Zealand and the Snares, Campbell, Auckland and Macquarie Islands. Four genera are present in New Zealand and the subantarctic islands.

Key to the New Zealand Genera in the Family Athoracophoridae

1	(4)	Mantle area extending to perinotum	
2	(3)	Posterior lateral margin of mantle area straight; not more than 15 lateral grooves on either side	Genus *Athoracophorus,* Gould, 1852.
3	(2)	Posterior lateral margin of mantle area running forwards before recurving to perinotum; more than 16 lateral grooves on either side	Genus *Reflectopallium,* n. gen.
4	(1)	Mantle area triangular or quadrangular, defined by grooves on all sides	
5	(6)	Anus not included in mantle area	Genus *Pseudaneitea,* Cockerell, 1891.
6	(5)	Anus included in mantle area	Genus *Palliopodex,* n. gen.

Genus Athoracophorus Gould, 1852, restr.

1850. *Janella* gray; not of Grateloup 1838.
1852. *Athoracophorus* Gould.
1891. *Neojanella* Cockerell.
1915. *Athoracophorus (Vomanus)* Iredale.
1937. *Vomanus* Powell.
1937. *Athoracophorus,* restricted Powell.

Slugs with the mantle area extending to the perinotum; mantle area with a straight posterior lateral margin. Head shield triangular, not extending to mantle area. Skin thin, lacking prominent papillae, with not more than 15 shallow lateral grooves on either side. Anus close to perinotum, lateral to renal orifice.

The genus *Athoracophorus* originally contained all the New Zealand and subantarctic slugs. However, other subgenera were subsequently erected, including *Athoracophorus* s. str. These subgenera were elevated to generic status by Powell in 1937. Thus the original genus was restricted to include only one species, *Athoracophorus bitentaculatus,* together with a subspecies, *Athoracophorus bitentaculatus rufovenosus,* which has been deleted. The genus now contains three species, one of them, *A. maculosus,* being new, and another, *A. suteri,* being transferred from the genus *Vomanus* Iredale, 1915.

The genus is widespread over the North and South Islands of New Zealand.

KEY TO THE SPECIES IN THE GENUS ATHORACOPHORUS.

1 (2)	10 to 15 shallow lateral grooves on either side, colour light buff or yellow, often with brown grooves and orange mantle area. Skin minutely granulate, papillae lacking	*Athoracophorus bitentaculatus* (Quoy and Gaimard), 1832.
2 (3)	Papillae broad and low, each one surrounded by a circle of black spots. 10 shallow lateral grooves either side, each one lying in a narrow buff stripe	*Athoracophorus maculosus* n. sp.
3 (1)	Renal orifice sometimes anterior to mantle area. 12 lateral grooves on either side; papillae rare, mantle area produced posteriorly to 3/5 body length. Usually blackish, marbled with pale brown, with yellowish mantle area	*Athoracophorus suteri* n. sp.

Athoracophorus bitentaculatus (Quoy and Gaimard). Pl. II, fig. 4.

1832. *Limax bitentaculatus,* Quoy and Gaimard, Voyage de l'Astrolabe, pp. 148–149, tab. 13, figs. 1–3.
1850. *Janella bitentaculata* Gray, *Figs. Moll. Anim.* 4, p. 112.
1852. *Athoracophorus bitentaculatus* Gould, United States Exploring Expedition, Mollusca, p. 2, tab. 1, figs. 6, 6a-c.
1853. *Janella antipodarum* Gray, p. 414.
1854. *Janella antipodarum* Gray, p. 112.
1859. *Limax bitentaculatus* and *Janella antipodarum* Knight, *Trans. Linn. Soc. Lond.,* 22, p. 381.
1880. *Janella bitentaculata* Hutton, Manual of the N.Z. Mollusca, p. 27.
1881. *Janella bitentaculata* Hutton, *Trans. Proc. N.Z. Inst.,* XIV, pp. 158–161.
1891. *Janella bitentaculata* and *Neojanella dubia* Cockerell, *Proc. zool. Soc. Lond.,* p. 217.
1892. *Janella bitentaculata* and *Neojanella dubia* Hedley, *Trans. Proc. N.Z. Inst.,* XXV, pp. 156–162.
1893. *Janella bitentaculata* Hedley and Suter, *Proc. Linn. Soc. N.S.W.,* Ser. II, VII (4), pp. 661–662.
1893. *Neojanella dubia* Suter, *Trans. Proc. N.Z. Inst.,* XXVI, p. 125.
1894. *Janella bitentaculata* and *J. maculata* Collinge, *Proc. zool. Soc. Lond.,* 1894, pp. 526–530.
1894. *Athoracophorus bitentaculatus* Suter, *J. Conchyliol.,* XLI, pp. 220–293.
1897. *Athoracophorus bitentaculatus, A. dubius, A. antipodum* Suter, *Proc. malac. Soc. Lond.,* II (6), pp. 246–256.
1898. *Athoracophorus bitentaculatus, A. dubius, Janella antipodum,* Plate, *Zool. Jb.* (Anat. und Ontog.), Jena, XI. pp. 193–269, figs. 12–17.
1909. *Athoracophorus bitentaculatus, A. b. rufovenosus* Suter. *Proc. malac. Soc. Lond.,* VIII (5), pp. 322–328.
1913. *Athoracophorus bitentaculatus, A. b. rufovenosus* Suter, Man. N.Z. Moll., pp. 792–794, Pl. 31, figs. 3, 4, 4a, 4b.
1937. *Athoracophorus bitentaculatus* and *A. b. rufovenosus,* Powell, Shell. N.Z., p. 123.
1956. *Athoracophorus bitentaculatus* Dell, *Trans. Roy. Soc. N.Z.,* 82.
1961. *Athoracophorus bitentaculatus* Burton, *Tuatara* IX (3).

This is an attractive species, light buff or yellow excepting the off-white sole and orange mantle area flanked by two parallel black stripes, sometimes with reddish-brown lateral grooves, and with a minutely granulate skin texture and a complete lack of papillae. The elongated body tapers to a pointed tail, is rounded dorsally when crawling, flattened and

longitudinally compressed when resting. The sole is smooth, relatively broad, divided into one broad median and two narrow lateral muscular zones, and bordered on either side by a narrow hyponotum. On the ventral surface, at about 1/20 body length, is a small, oval mouth, bordered anteriorly by two oval preoral lobes and separated from the sole by a deep, narrow, transverse furrow. The head shield is small, equilaterally triangular with the base anterior, bisected by a median groove, the sides defined by two convex grooves commencing between the preoral lobes, emerging onto the dorsum lateral to the tentacles, and running back to the midline. The head shield carries a pair of tentacles anteriorly, and the genital orifice, a short, narrow, slightly curved slit, in the right margin lateral to the tentacle. The tentacles are up to 4mm long, basally sheathed, medially narrowed and apically swollen with small black eyes at the tips. They are retracted in preserved specimens. The mantle area extends diagonally back across the dorsum to the perinotum on the right side, is defined on the left by the median groove, and contains a central, circular, lipped pulmonary aperture, and a lobed renal orifice in the anterior apex at 1/4 body length. The anus is close to the perinotum, lateral to the renal orifice, and usually bordered by pre- and post-anal grooves which are the anterior branches of the fifth right lateral groove. A major median groove runs the length of the back to bifurcate at the tail. Ten to 15 shallow lateral grooves, unbranched at the head and nearly all bifid or trifid elsewhere, arise from the head shield, mantle area, and median groove and run diagonally across the back to the hyponotum.

Dimensions of large specimen: total length, 38mm; maximum breadth, 9mm; head to renal orifice, 8.5mm; anus to perinotum, 1mm; length of head shield, 5mm.

LOCALITIES. Suter's localities given for this species are:—Bay of Islands, Thames, Waiheke Is., Wairangi, Palmerston North, Heretaunga, Dannevirke, Forty Mile Bush, Wellington, Tasman Bay, Pelorus Valley, Collingwood, Greymouth, Dunedin, Capleston, Tuakau, Waitakeres, Stratford. It has also been collected from the following localities:—New Plymouth, Atene, Waitewaewae, Orongorongo Valley, Sayers Track (west of Carterton), Stewart Island (R. K. Dell), Pirinoa, Wainui-o-mata, Mangahao, Mt. Stokes, Kaitoke.

REMARKS. This species is the commonest of the New Zealand Athoracophoridae. Superficially it most resembles *A. suteri,* but it may be readily distinguished by its possession of more lateral grooves and a generally lighter coloration. The colour pattern is subject to considerable variation. On the basis of the colour patterns, and also on the evidence afforded by the anal grooves, a subspecies, *A. bitentaculatus rufovenosus* Suter, and a variety, *A. b. antipodum* (Gray), have been described. From an examination of the specimens before me, it appears that neither the subspecies nor the variety are justifiable. Various combinations of the basic elements of the colour patterns occur, and intergradations between the described colour patterns are common. The position of the anal grooves also varies, and a preanal groove is often found with an *Athoracophorus bitentaculatus* colour pattern, thus invalidating Suter's diagnostic character for the subspecies.

The species is found only in or near bush, in moist areas with over 50in annual rainfall. It is nocturnal and fungivorous, and is commonly found at night eating a black encrusting fungus (*Capnodium moniliforme* Fraser) on the leaves of *Pseudowintera axillaris* and *P. colorata.* The eggs are round, papillate, gelatinous, light yellow in colour, and from 2 to 3mm in diameter. They are laid in clusters of 15 to 20 in damp, cool surroundings. When hatched, the slug is 9 to 10mm long, with all structures fully visible.

"**Konophora marmorea** Hutton, 1878."

1878. *Konophora marmorea* Hutton, *Trans. Proc. N.Z. Inst.,* p. 332.
1880. *Konophora marmorea* Hutton, *Man. N.Z. Moll.*
1881. *Janella marmorea* Hutton, *Trans. Proc. N.Z. Inst.,* p. 158, Pl. 5, figs. 1, 2.
1894. *Athoracophorus (Conophora) marmorea,* Suter, *J. Conchyliol,* XLI, pp. 220–293.
1897. *Athoracophorus (Conophora) marmorea,* Suter, *Proc. malac. Soc. Lond.,* II (6), pp. 246–256.

1898. *Janella marmorea,* Plate, *Zool. Jb.* (Anat. und Ontog.), Jena, XI, p. 273.
Non: *Athoracophorus (Conophora) marmorea* Suter, 1909.

This species is almost unrecognisable from Hutton's description, and until the type specimen is found *Konophora marmorea* must remain *incertae sedis.* In fact, perhaps the only species to which Hutton's description could not possibly apply is Suter's *Athoracophorus (Conophora) marmorea.* Hutton's description can, however, be recognised as that of a member of the Athoracophoridae.

Athoracophorus maculosus n. sp. (Pl. 2, fig. 5).

This is a striking species, growing up to 33mm long, yellowish-buff excepting the off-white sole and hyponotum, with a circle of black spots surrounding each broad, low papillum, and a narrow buff stripe margining each dorsal groove. The broad, dorsally flattened body tapers slightly to a bluntly rounded tail. The sole is smooth, broad, divided into one broad median and two narrow lateral muscular zones, and bordered by a narrow hyponotum. On the ventral surface, at about 1/20 body length, is a small, oval mouth, bordered anteriorly by two oval preoral lobes, and separated from the sole by a deep, narrow, transverse furrow. The head shield is small, equilaterally triangular with the base anterior, bisected by a median groove, the sides defined by two convex grooves commencing between the preoral lobes, emerging onto the dorsum lateral to the tentacles, and running back to the midline. The head shield carries a pair of tentacles anteriorly, and the genital orifice, a short, narrow, slightly curved slit, in the right margin lateral to the tentacle. The tentacles are retracted in all specimens examined. The mantle area extends diagonally back across the dorsum to the perinotum on the right side, is defined on the left by the median groove, carries a lobed renal orifice in its anterior apex at about 1/5 body length and bears a central, circular, lipped pulmonary aperture. The anus is close to the perinotum lateral to the renal orifice, and is bordered by pre- and post-anal grooves which are the bifurcations of the third right lateral groove. A major median groove runs the length of the back to bifurcate at the tail. Ten shallow lateral grooves, unbranched at the head and tail and sometimes bifid elsewhere, arise from the head shield, mantle area, and median groove, and run diagonally across the back to the hyponotum.

Dimensions. (Type specimen).

Total length, 32.5mm; maximum breadth, 10mm; head to renal orifice, 7.5mm; anus to perinotum, 0.5mm; renal orifice to pulmonary aperture, 2mm. Type in Dominion Museum, Wellington. Collected at Karamea Bluff, 1949.

LOCALITIES. Karamea Bluff, Marris Tramway, Canaan, Bainham.

REMARKS. One specimen (from Canaan) was so poorly preserved that it could be identified only by the distinctive arrangement of black spots around the papillae. So far the species has not been found outside North-west Nelson.

Athoracophorus suteri nom. nov. (Pl. III, fig. 4).

1909. *Athoracophorus (Conophora) marmorea* Suter, *Proc. malac. Soc. Lond.,* VIII (5), pp 322–328.
Non: *Konophora marmorea* Hutton, 1878.
1913. *Athoracophorus (Conophora) marmorea* Suter, Man. N.Z. Moll., p. 795, Pl. 31, fig. 5.
1915. *Athoracophorus (Vomanus) marmoreus,* Iredale, *Trans. Proc. N.Z. Inst.,* XLVII, p. 483.
1937. *Vomanus marmoreus,* Powell, Shell. N.Z., p. 123.

This species grows up to 50mm long, and is usually blackish, marbled with pale brown, excepting the off-white sole and hyponotum, and yellowish pulmonary aperture, with smooth or finely granulate skin texture and, rarely, small papillae. The cylindrical, elongate body tapers to a pointed tail. The sole is smooth, relatively broad, tapers to a pointed posterior tip, is divided into one broad median and two narrow lateral muscular zones, and bordered on either side by a narrow hyponotum. On the ventral surface at about 1/20 body length is a small, oval mouth, bordered anteriorly by a pair of oval preoral lobes, and separated from the sole by a deep, narrow, transverse furrow. The head shield is small, equilaterally triangular with the base anterior, bisected by a median groove, the sides defined by two convex grooves commencing between the preoral lobes, emerging onto the dorsum lateral to the tentacles, and running back to the midline. The head shield carries a pair of

tentacles anteriorly, and the genital orifice, a short, narrow, slightly curved slit, in the right margin lateral to the tentacle. The tentacles are retracted in all preserved specimens. The mantle area flanks the midline for about 1/5 body length before curving to extend diagonally back across the dorsum to the hyponotum on the right side, is defined on the left by the median groove, and contains a central, circular, lipped pulmonary aperture and a lobed renal orifice in its anterior apex at 1/5 body length. The anus is close to the perinotum, lateral to the renal orifice, and lacks pre- and post-anal grooves. A major median groove runs along the back to bifurcate at 7/10 body length. Twelve narrow, deep, lateral grooves, unbranched at head and tail, occasionally bifid elsewhere, arise from the head shield, mantle area, and median groove and run diagonally across the back to the hyponotum. Dimensions: Total length, 30mm; maximum breadth, 15mm; head to renal orifice, 6mm; anus to perinotum, 1mm. Animal contracted during preservation.

Type. In the Otago Museum, Dunedin.

Localities. Resolution Is.; Ashburton; Great Barrier Is.; Mount Hut, Tongariro District (H. Suter); Stephens Is. (B. A. Holloway).

Remarks. Suter placed this species in the subgenus *Conophora,* stating that the renal orifice was " in most specimens " separated from the mantle area by a groove, which was " more or less distinct ". In the present material examined, however, there is no sign at all of any such groove, though all other features are in accordance with Suter's description. It appears that a very unreliable character has been used by Suter to differentiate the subgenus, and as the species resembles the Athoracophorids closely, it is logical to include it within the genus *Athoracophorus.*

The subgeneric name originally proposed underwent some alteration before Powell raised the subgenus to generic status in 1937. Hutton put forward the name *Konophora,* which was emended by Suter to *Conophora.* In 1915, Iredale pointed out that this name was invalid, as there was a prior *Conophorus* Meigen, 1803, *Mag. f. Insek.* (III) ii, p. 268, and he argued that this was obviously the same name. He then put forward the name *Vomanus,* which stood.

Suter, 1913, states that the colour is very variable, but as the species is very widely distributed a considerable amount of variation is to be expected.

As the specific name *marmorea* is preoccupied by Hutton's doubtful *Konophora marmorea* 1879, the name *Athoracohporus suteri* is proposed. It is quite certain that Hutton's *K. marmorea* is not the same species as the one described by Suter.

Genus Reflectopallium n. gen.

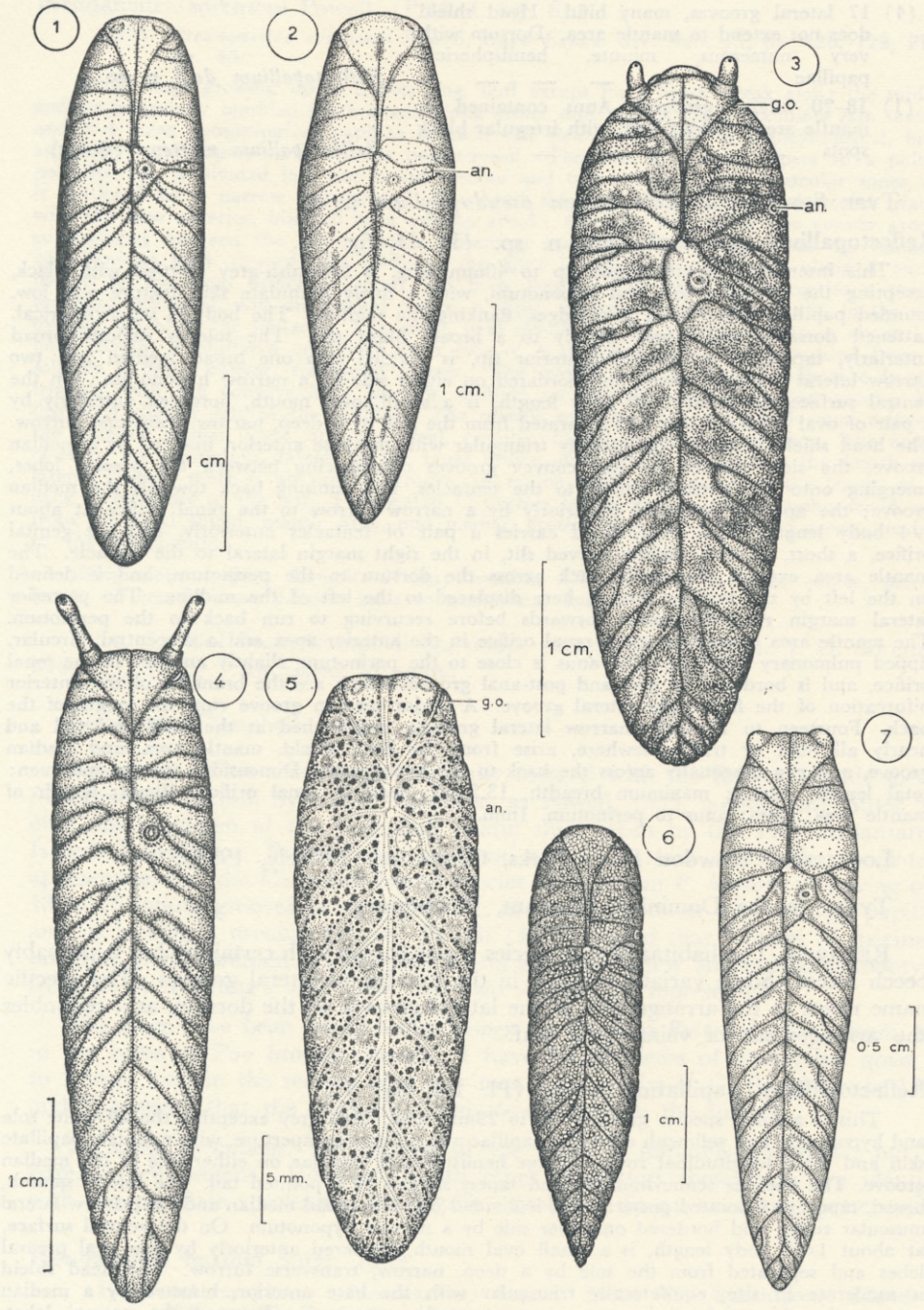
Slugs with the mantle area extending to the perinotum; the mantle area with the posterior lateral margin running diagonally forwards before recurving to run back to the perinotum. Head shield usually extending to mantle area. Skin thick, often with papillae, with not less than 14 lateral grooves on either side. Anus close to perinotum, sometimes contained in mantle area.

The genus contains four species, three of them new, and the fourth, *Reflectopallium martensi* (Suter), being transferred from *Pseudaneitea* Cockerell. The genus is found mainly in the South Island, with *R. martensi* (Suter) occurring in the Auckland Islands.

Key to the Species in the Genus Reflectopallium

1 (2) 14 to 18 lateral grooves, all bifid or trifid; papillae low and rounded, often fused into low, rounded ridges. Colour brownish-grey ..... *Reflectopallium pseudophyllum* n. sp

2 (3) 17 lateral grooves, mostly unbranched. Three longitudinal rows of hemispherical papillae on either side. Colour dark grey with white papillae ..... *Reflectopallium papillatum* n. sp.



TEXT-FIG. 2

FIG. 1.—*Reflectopallium martensi.* FIG. 2.—*Palliopodex verrucosus.* FIG. 3.—*Reflectopallium pseudophyllum.* FIG. 4.—*Athoracophorus bitentaculatus.* FIG. 5.—*Athoracophorus maculosus.* FIG. 6.—*Pseudaneitea aspera.* FIG. 7.—*Pseudaneitea powelli.*
An., anus; g.o., genital orifice.

3 (4) 17 lateral grooves, many bifid. Head shield does not extend to mantle area. Dorsum with very numerous, minute, hemispherical papillae ..... *Reflectopallium delli* n. sp.

4 (1) 18–20 lateral grooves. Anus contained in mantle area. Colour buff, with irregular black spots ..... *Reflectopallium martensi* (Suter)

TYPE SPECIES. *Reflectopallium pseudophyllum* n. sp.

Reflectopallium pseudophyllum n. sp. (Pl. II, fig. 3).

This interesting species grows up to 40mm long, is brownish-grey mottled with black, excepting the off-white sole and hyponotum, with a finely granulate skin texture and low, rounded papillae, often fused into ridges, flanking the midline. The body is semicylindrical, flattened dorsally, and tapers slightly to a broad, blunt tail. The sole is smooth, broad anteriorly, tapers to a rounded posterior tip, is divided into one broad median and two narrow lateral muscular zones, and bordered on either side by a narrow hyponotum. On the ventral surface, at about 1/20 body length, is a small, oval mouth, bordered anteriorly by a pair of oval preoral lobes, and separated from the sole by a deep, narrow, transverse furrow. The head shield is small, equilaterally triangular with the base anterior, bisected by a median groove, the sides defined by two convex grooves commencing between the preoral lobes, emerging onto the dorsum lateral to the tentacles, and running back towards the median groove; the apex is produced posteriorly by a narrow furrow to the renal orifice at about 1/4 body length. The head shield carries a pair of tentacles anteriorly, and the genital orifice, a short, narrow, slightly curved slit, in the right margin lateral to the tentacle. The mantle area extends diagonally back across the dorsum to the perinotum, and is defined on the left by the median groove, here displaced to the left of the midline. The posterior lateral margin runs diagonally forwards before recurving to run back to the perinotum. The mantle area contains a lobed renal orifice in the anterior apex and a subcentral, circular, lipped pulmonary aperture. The anus is close to the perinotum, slightly anterior to the renal orifice, and is bordered by pre- and post-anal grooves which are the branches of the anterior bifurcation of the fifth right lateral groove. A major median groove runs the length of the back. Fourteen to 18 deep, narrow lateral grooves, unbranched at the head and tail and nearly all bifid or trifid elsewhere, arise from the head shield, mantle area, and median groove, and run diagonally across the back to the hyponotum. Dimensions of type specimen: total length, 40mm; maximum breadth, 13.5mm; head to renal orifice, 10mm; length of mantle area, 5mm; anus to perinotum, 1mm.

LOCALITIES. Hawdon River Forks, Canterbury (Wisely, 1950).

TYPE. In the Dominion Museum, Wellington.

REMARKS. The habitat of this species is not known with certainty, but is probably beech forest. Some variation occurs in the number of lateral grooves. The specific name refers to the arrangement of the lateral grooves on the dorsum, as it resembles the arrangement of veins on a leaf.

Reflectopallium papillatum n. sp. (Pl. III, fig. 5).

This is a small species growing up to 29mm long, dark grey excepting the off-white sole and hyponotum and yellowish off-white papillae and pulmonary aperture, with minutely papillate skin and three longitudinal rows of large hemispherical papillae on either side of the median groove. The body is semicylindrical and tapers sharply to a pointed tail. The sole is smooth, broad, tapers to a pointed posterior tip, is divided into one broad median and two narrow lateral muscular zones, and bordered on either side by a narrow hyponotum. On the ventral surface, at about 1/20 body length, is a small oval mouth, bordered anteriorly by two oval preoral lobes and separated from the sole by a deep, narrow, transverse furrow. The head shield is moderate in size, equilaterally triangular with the base anterior, bisected by a median groove, the sides defined by two convex grooves commencing between the preoral lobes, emerging onto the dorsum lateral to the tentacles, and running back towards the midline; the apex is produced posteriorly by a narrow furrow to the renal orifice at about 3/10 body length. The head shield carries a pair of tentacles anteriorly, and the genital orifice, a short, narrow, slightly curved slit, in the right margin lateral to the tentacle. The mantle area extends diagonally back across the dorsum to the hyponotum, is defined on the left by the median groove, here displaced slightly left of the midline, and carries a lobed renal orifice

in the anterior apex and a central, circular, lipped pulmonary aperture. The posterior lateral margin of the mantle area runs diagonally forwards before curving sharply to run back to the perinotum. The anus is close to the perinotum, slightly anterior to the renal orifice, and lacks pre- and post-anal grooves. A major median groove runs the length of the back. Seventeen narrow lateral grooves, unbranched at the head and tail and occasionally bifid or trifid elsewhere, arise from the head shield, mantle area and median groove and run diagonally across the back to the hyponotum.

Dimensions: Total length, 29mm; maximum breadth, 7.5mm; length of mantle area, 4.2mm; head to renal orifice, 9mm; anus to perinotum, 1mm.

Type. In the Dominion Museum, Wellington.

Locality. Mt Algidus, Canterbury (Forster, 1946).

Remarks. The habitat of this species is mainly sub-alpine grassland and scrub. Only two specimens have been collected, and more collecting is needed before the characteristics of the species and the extent of its range can be determined.

Reflectopallium delli n. sp. (Pl. III, fig. 6).

This species grows up to 30mm long, and is brownish-buff with clusters of small, round, longitudinally arranged black spots on the back, merging near the midline to form two black streaks flanking the median groove from the head shield and fading halfway along the back. The skin is covered with minute, hemispherical, discrete papillae. The body is cylindrical, and tapers from 3/5 body length to a pointed tail. The sole is smooth, broad anteriorly, divided into one broad median and two narrow lateral muscular zones, and bordered by a narrow hyponotum. On the ventral surface at about 1/20 body length is a small oval mouth, bordered anteriorly by two oval preoral lobes, and separated from the sole by a deep, narrow, transverse furrow. The head shield is small, equilaterally triangular with the base anterior, bisected by a median groove, the sides defined by two convex grooves commencing between the preoral lobes, emerging on to the dorsum lateral to the tentacles, and running back to the median groove. The head shield carries a pair of tentacles anteriorly, and the genital orifice, a short, narrow, slightly curved slit, in the right margin lateral to the tentacle. The mantle area extends diagonally back across the dorsum from the median groove to the perinotum, and contains a lobed renal orifice in its anterior apex and a central, circular, lipped pulmonary aperture. The posterior lateral margin of the mantle area runs diagonally forwards before curving sharply to run back to the perinotum. The anus is close to the perinotum lateral to the renal orifice, and is bordered by pre- and post-anal grooves which are the branches of the fifth right lateral groove. A major median groove runs the length of the back to bifurcate at the tail. Seventeen narrow, shallow lateral grooves, the majority bifurcating near the perinotum, arise from the head shield, mantle area, and median groove, and run diagonally across the back to the perinotum.

Dimensions: Total length, 30mm; breadth, 9.5mm; head to renal orifice, 7mm; anus to perinotum, 0.5mm.

Type Specimen. In the Dominion Museum, Wellington.

Locality. Central Trio Island, Pelorus Sound.

Remarks. The species is distinctive in possessing an abnormal skin texture. The small hemispherical papillae covering the back are distinct from each other, and not crowded together as in *Pseudaneitea aspera*. The habitat is low bush and scrub.

Reflectopallium martensi (Suter) (Pl. II, fig. 1).

1889. *Athoracophorus marmoratus* Simroth, *Nova. Acta. Leop. Carol.*, LIV, p. 71, Pl. IV, figs. 3–10. Non *A. marmoreus* Hutton 1879.
1909. *Athoracophorus (Amphiconophora) martensi* Suter, nom. nov. for *Athoracophorus marmoratus* Simroth non *A. marmoreus* Hutton 1879, The Subantarctic Islands of New Zealand, Vol. I, p. 40.
1909. *Athoracophorus (Pseudaneitea) martensi* Suter, *Proc. malac. Soc. Lond.*, VIII (5), p. 324.
1913. *Athoracophorus (Pseudaneitea) martensi* Suter, Man. N.Z. Moll., p. 800, Pl. 31, figs. 8, 8a.
1937. *Pseudaneitea martensi* Powell, Shell. N.Z., p. 123.
1955. *Pseudaneitea martensi* Powell, *Cape Exped. Ser. Bull.* 15, p. 129.

This species grows up to 46mm long, with a yellowish back and sole, irregular black spots on the back tending to concentrate near the midline, a finely wrinkled skin texture, and a complete lack of papillae. The body is semicylindrical and tapers to a bluntly pointed tail. The sole is narrow, smooth, tapers to a pointed posterior tip, is divided into one broad median and two narrow lateral muscular zones, and is bordered on either side by a broad hyponotum. On the ventral surface at about 1/20 body length is a small, oval mouth, bordered anteriorly by a pair of oval preoral lobes, and separated from the sole by a deep, narrow, transverse furrow. The head shield is a large isosceles triangle with the narrow base anterior, bisected by a median groove, the sides defined by two convex grooves commencing between the preoral lobes, emerging onto the dorsum lateral to the tentacles, running diagonally back towards the midline, then curving to form a narrow furrow to the renal orifice at 1/4 body length. The head shield bears a pair of tentacles anteriorly, and the genital orifice, a short, narrow, slightly curved slit, in the right margin lateral to the tentacle. The tentacles are retracted in all specimens. The mantle area, defined on the left by the median groove and occupying 1/10 body length, has its lateral apex produced by a narrow strip, containing the anus, straight across the back to the hyponotum. It contains a lobed renal orifice in the anterior median apex, and a central, circular, lipped pulmonary aperture. A major median groove runs along the back to bifurcate at the tail. Eighteen to 20 narrow lateral grooves, unbranched at the head and tail and sometimes bifid elsewhere, arise from the head shield, mantle area and median groove, and run diagonally across the back to the hyponotum.

Dimensions: Total length, 31mm; maximum breadth, 8.5mm; head to renal orifice, 7.5mm; anus to perinotum, 2mm.

LOCALITY. Auckland Islands.

TYPE. In the Kgl. Museum fur Naturkunde, Berlin.

REMARKS. In his first description of this species, Suter stated that the mantle area was triangular, and thus placed the species in the subgenus *Pseudaneitea* Cockerell, 1891. However, in his 1913 description of the species he mentions that the mantle area is narrowly open on the right side, but does not transfer the species from the Pseudaneiteids, although in his diagnosis of the subgenus he states that the mantle area is "distinct, triangular or rarely quadrangular". This diagnosis must automatically exclude the species from the genus *Pseudaneitea*. Powell made no reference to the discrepancy in 1955. It appears that the most satisfactory solution is to place the species in the new genus *Reflectopallium*.

Genus PALLIOPODEX n. gen.

TYPE. *Palliopodex verrucosus* (Simroth) 1889.

1897. *Athoracophorus (Amphiconophora)* Suter.
1937. *Amphiconophora* Powell.

Slugs with the mantle area broader than long, triangular, containing the anus in the lateral apex, and defined entirely by the median groove and two lateral grooves. The only species has 20 lateral grooves on either side, nearly all unbranched.

This genus originally contained two species, *Amphiconophora gigantea* and *A. verrucosa*. Taking the distribution of these species and their anatomy into account, it seems far more reasonable to transfer *Amphiconophora gigantea* Suter to the genus *Pseudaneitea* Cockerell, and to leave *A. verrucosus* in a genus by itself. As *A. gigantea* is the type species for the genus, this step makes *Amphiconophora* Suter 1897, synonymous with *Pseudaneitea* Cockerell 1891, as the genus *Pseudaneitea* was erected six years before *Amphiconophora*. It thus becomes necessary to erect a new genus to accommodate *A. verrucosa*. The genus erected, *Palliopodex*, is so named because the anus is found within the mantle area.

Palliopodex verrucosus (Simroth) 1889. (Pl. II, fig. 2.)

1889. *Athoracophorus verrucosus* Simroth, *Nova. Acta. Leop.-Carol. Deutsch Akad. Naturf.*, p. 77, Pl. 4, figs. 11–14.
1891. *Athoracophorus verrucosus*, Cockerell, *Proc. zool. Soc. Lond.*, p. 217.

1892. *Janella verrucosa,* Hedley, *Trans. Proc. N.Z. Inst.,* XXV, p. 158.
1893. *Janella verrucosa,* Hedley and Suter, *Proc. Linn. Soc. N.S.W.,* Ser. 2, VII, (4), pp. 661–662.
1894. *Athoracophorus verrucosus,* Suter, *J. Conchyliol.,* XLI, p. 235.
1897. *Athoracophorus (Pseudaneitea) papillatus,* Suter, *Proc. malac. Soc. Lond.,* II (6), p. 251.
1898. *Janella verrucosa,* Plate, *Zool. Jb.,* (Anat. und Ontog.) Jena, XI, p. 201, Pl. 9, figs. 10, 11.
1909. *Athoracophorus (Amphiconophora) verrucosa,* Suter, The Subantarctic Islands of N.Z., Vol. I, p. 40.
1913. *Athoracophorus (Amphiconophora) verrucosa,* Suter, M.N.Z.M., p. 806, Pl. 31, fig. 13.
1937. *Amphiconophora verrucosa,* Powell, Shell. N.Z., p. 123.
1955. *Amphiconophora verrucosa,* Powell, *Cape Exped. Ser. Bull.* 15, p. 129.

This is a small species, growing up to 30mm long, uniformly black or yellowish-brown with a median black stripe, with a yellowish off-white sole and hyponotum, a minutely granular skin texture, and very numerous small, conical papillae, usually retracted in preserved material. The broad body tapers to a bluntly pointed tail. The sole is smooth, broad anteriorly, tapers to a pointed posterior tip, is divided into one broad median and two narrow lateral muscular zones, and is bordered on either side by a narrow hyponotum. On the ventral surface at about 1/20 body length is a small oval mouth, bordered anteriorly by a pair of oval preoral lobes, and separated from the sole by a deep, narrow, transverse furrow. The head shield is large, equilaterally triangular with the base anterior, bisected by a median groove, the sides defined by two convex grooves commencing between the preoral lobes, emerging onto the dorsum lateral to the tentacles, and running back towards the median groove; the apex is produced posteriorly by a narrow furrow to the renal orifice at about 3/10 body length. The head shield carries a pair of tentacles anteriorly, and the genital orifice, a short, narrow, slightly curved slit, in the right margin lateral to the tentacle. The tentacles are retracted in preserved specimens. The mantle area is an isosceles triangle, based on the median groove, extending straight across the back to include the anus in its lateral apex. It contains a lobed renal orifice in the anterior apex, and a central, circular, lipped pulmonary aperture. A major median groove runs the length of the back to bifurcate at the tail. Twenty narrow lateral grooves, nearly all unbranched, arise from the head shield, mantle area, and median groove, and run diagonally across the back to the hyponotum.

Two varieties of this species have been described, both of them based on coloration.

Var. *nigricans* Simroth, 1889.

Dorsum uniformly black, hyponotum yellowish, densely sprinkled with black spots, yellowish-white sole and mouth.

Var. *fasciatus* Simroth, em. (*fuscatus*), 1889.

Yellowish-brown with a black band along the median groove, and two narrower bands of black streaks and spots flanking the midline on either side.

The anatomy and external morphology of each variety are identical in every other respect.

Dimensions: Total length, 29mm; maximum breadth, 9mm; head to renal orifice, 8mm; anus to perinotum, 4mm.

LOCALITY. Auckland Islands.

TYPE. In the Kgl. Museum fur Naturkunde, Berlin.

REMARKS. Suter's description states that the back is covered with small, sharply raised papillae. Unfortunately all the present material had been preserved for some time, and the papillae were retracted.

Genus PSEUDANEITEA Cockerell, 1891.

Amphiconophora Suter, 1897.

TYPE. *Pseudaneitea papillata* (Hutton) 1878.

Slugs with a small triangular or rarely quadrangular mantle area, bearing a lobed renal orifice in the anterior apex and a central pulmonary aperture. Skin finely granulate, usually

with raised, retractable papillae between the lateral grooves. Anus lying between mantle area and perinotum, nearly always bordered by the bifurcations of a lateral groove. Lateral grooves narrow, numbering from 14 to 22 on either side, and extending onto hyponotum.

This is the largest of the New Zealand genera of Athoracophoridae, with ten known species distributed over the North and South Islands, and a further three species in the subantarctic islands. It was first erected as a subgenus by Cockerell in 1891 to accommodate Hutton's *Janella papillata* 1878, and was defined solely on the basis of the mantle area. This subgenus was raised to generic status by Powell in 1937, and though no comment was made on the change, there is no doubt that it was justified, as the Pseudaneiteids form a well-knit group quite different in nature from the genus *Athoracophorus*. The Pseudaneiteids are generally much larger, with thicker skin, more lateral grooves, and numerous papillae.

Key to the Species of the Genus Pseudaneitea.

1	(4)	Anus adjoining outer angle of mantle area	
2	(3)	Mantle area quadrilateral. Seventeen lateral grooves, very few unbranched. Numerous irregular black spots on the dorsum. Campbell Is.	*Pseudaneitea campbellensis* n. sp.
3	(2)	Mantle area triangular. Fifteen lateral grooves, the majority unbranched; median groove broad, black. Numerous irregular black spots on dorsum. West Coast, Fiordland	*P. gigantea* (Suter)
4	(1)	Anus close to perinotum	
5	(9)	Large papillae lacking	
6	(7)	Skin densely covered with small papillae. Twenty lateral grooves, the majority unbranched; preanal groove lacking. Upper Mason River valley	*P. aspera* n. sp.
7	(8)	Seventeen very deep lateral grooves. Skin minutely granulate, dorsum with numerous longitudinally arranged black spots. Preanal groove present. Picton	*P. gravisculca* n. sp.
8	(5)	Nineteen lateral grooves, the majority unbranched. Mantle area usually quadrilateral; low rounded ridges in some side fields. Dark grey or brown. Queenstown, Te Anau	*P. powelli* n. sp.
9	(4)	Large papillae present in side fields	
10	(13)	Papillae conical	
11	(12)	Twenty-two narrow lateral grooves; up to 7 papillae in each side field. Dark grey, with prominent perinotal ridge. Stewart Island	*P. multistriata* n. sp.
12	(11)	Fifteen-seventeen lateral grooves; up to 5 papillae in each side field. Olive green or dark grey, papillae black tipped. Widespread	*P. papillata* (Hutton)
13	(10)	Papillae rounded	
14	(16)	Preanal groove lacking	
15	(14)	Thirteen-fifteen lateral grooves. Up to four papillae in a side field. Colour buff with irregular black streaks. Campbell Island	*P. sorenseni* Powell
16	(14)	Preanal groove present	
17	(20)	Lateral grooves nearly all unbranched	
18	(19)	Eighteen-twenty-one lateral grooves. Up to 5 papillae in a side field. Light yellow with two rows of black spots flanking midline. Snares Is.	*P. huttoni* Suter

19 (18)	Seventeen lateral grooves. Up to 2 small papillae in a side field. Buff with irregular black spots. Ship Cove	*P. maculata* n. sp.
20 (17)	More than 3 lateral grooves branching	
21 (22)	Fifteen lateral grooves on either side. Papillae large, oval, crowded, 3–4 in each side field. Collingwood	*P. simrothi* Suter
22 (23)	Fourteen-sixteen branching lateral grooves. Large rounded papillae in single row either side anterior to mantle area, double row posterior. Mantle area frequently quadrilateral. Dark grey. Mid-Canterbury	*P. dendyi* Suter
23 (24)	Sixteen lateral grooves. Two-three large papillae in each side field. Colour grey, with large black spot on posterior apex of mantle area. D'Urville Island	*P. johnsi* n. sp.
24 (20)	Fifteen shallow lateral grooves. Three-four papillae in each side field. Notum densely covered with small black spots. Pelorus Sound	*P. schauinslandi* (Plate)

Pseudaneitea papillata (Hutton) 1878. (Pl. I, fig. 1.)

1878. *Janella papillata* Hutton, *Trans. Proc. N.Z. Inst.*, XI, pp. 331, 332.
1880. *Janella papillata* Hutton, Man. N.Z. Moll., p. 27.
1881. *Janella papillata* Hutton, *Trans. Proc. N.Z. Inst.*, XIV, pp. 158–161.
1883. *Janella bitentaculata* var. *papillata* Hutton, *Trans. Proc. N.Z. Inst.*, XVI, p. 206.
1892. *Janella bitentaculata* var. *papillata*, Hedley, *Trans. Proc. N.Z. Inst.*, XXV, p. 158.
1893. *Janella papillata*, Hedley and Suter, *Proc. Linn. Soc. N.S.W.*, Ser. 2, VII (4), pp. 661, 662.
1893. *Athoracophorus (Pseudaneitea) papillatus*, Suter, *Trans. Proc. N.Z. Inst.*, XXVI, pp. 123–125.
1894. *Athoracophorus (Pseudaneitea) papillatus*, Suter, *J. Conchyliol.*, XLI, p. 235.
1897. *Athoracophorus (Pseudaneitea) papillatus*, Suter, *Proc. malac. Soc. Lond.*, II, (6), p. 251.
1898. *Janella papillata*, Plate, *Zool. Jb.*, XI, p. 202, Pl. XIV, fig. 39.
1909. *Athoracophorus (Pseudaneitea) papillatus*, Suter, *Proc. malac. Soc. Lond.*, VIII (5), 325.
1913. *Athoracophorus (Pseudaneitea) papillatus*, Suter, Man. N.Z. Moll., p. 801, Pl. XXXI, figs. 9, 9a.
1937. *Pseudaneitea papillata*, Powell, Shell. N.Z., p. 123.
1962. *Pseudaneitea papillata*, Burton, *Tuatara*, 9 (3), pp. 87– 97.

This is a handsome species growing up to 101mm long, dark olive green excepting the off-white sole and hyponotum, with black head shield and mantle area and obvious black-tipped, conical papillae ranging up to 2mm in diameter near the mid-dorsal line. The body is cylindrical, the back broadly convex, and the tail tapers to a blunt point. When the animal is at rest, the tentacles are partially retracted, the head shield recessed, the anterior portion of the perinotum protruded on either side, and the body longitudinally compressed to half the length attained while crawling. The sole is smooth, broad anteriorly, tapers to a rounded posterior tip, is divided into one broad median and two narrow lateral muscular zones, and is bordered on either side by a narrow hyponotum. On the ventral surface, at about 1/20 body length, is a small, oval mouth, bordered anteriorly by two oval preoral lobes, and separated from the sole by a deep, narrow, transverse furrow. The head shield is small, equilaterally triangular with the base anterior, bisected by a median groove, the sides defined by two convex grooves commencing between the preoral lobes, emerging onto the dorsum lateral to the tentacles, and running back to the midline; rarely the apex is produced posteriorly to the renal orifice at about 1/4 body length. The head shield carries a pair of tentacles anteriorly, and the genital orifice, a short, narrow, slightly curved slit, in the right margin lateral to the tentacle. The tentacles are up to 6mm long, basally sheathed, medially narrowed, and apically swollen with small black eyes at the tips. They are retracted in preserved specimens. The mantle area is a small, acute isosceles triangle with the base anterior, occupying about 1/10 body length and about 1½ times as long as broad, defined on the left by the median groove, here displaced slightly left of the midline. It contains the

renal orifice, covered by a small circular lobe attached on its posterior side, in the anterior median apex, and a central, circular, lipped pulmonary aperture. The anus is close to the perinotum, lateral to the renal orifice, and is bordered by pre- and post-anal grooves which are the anterior branches of the fourth right lateral groove; rarely, the anus lies on the pre-anal groove. A major median groove runs the length of the back to bifurcate at the tail. Fifteen-seventeen deeply incised lateral grooves, unbranched at the head and tail and with two, three, or four branches elsewhere, arise from the head shield, mantle area, and median groove and run diagonally across the back to the hyponotum.

Dimensions: Total length, 101mm; maximum breadth, 22mm; head to renal orifice, 26mm; length of mantle area, 7.5mm; anus to perinotum, 3mm.

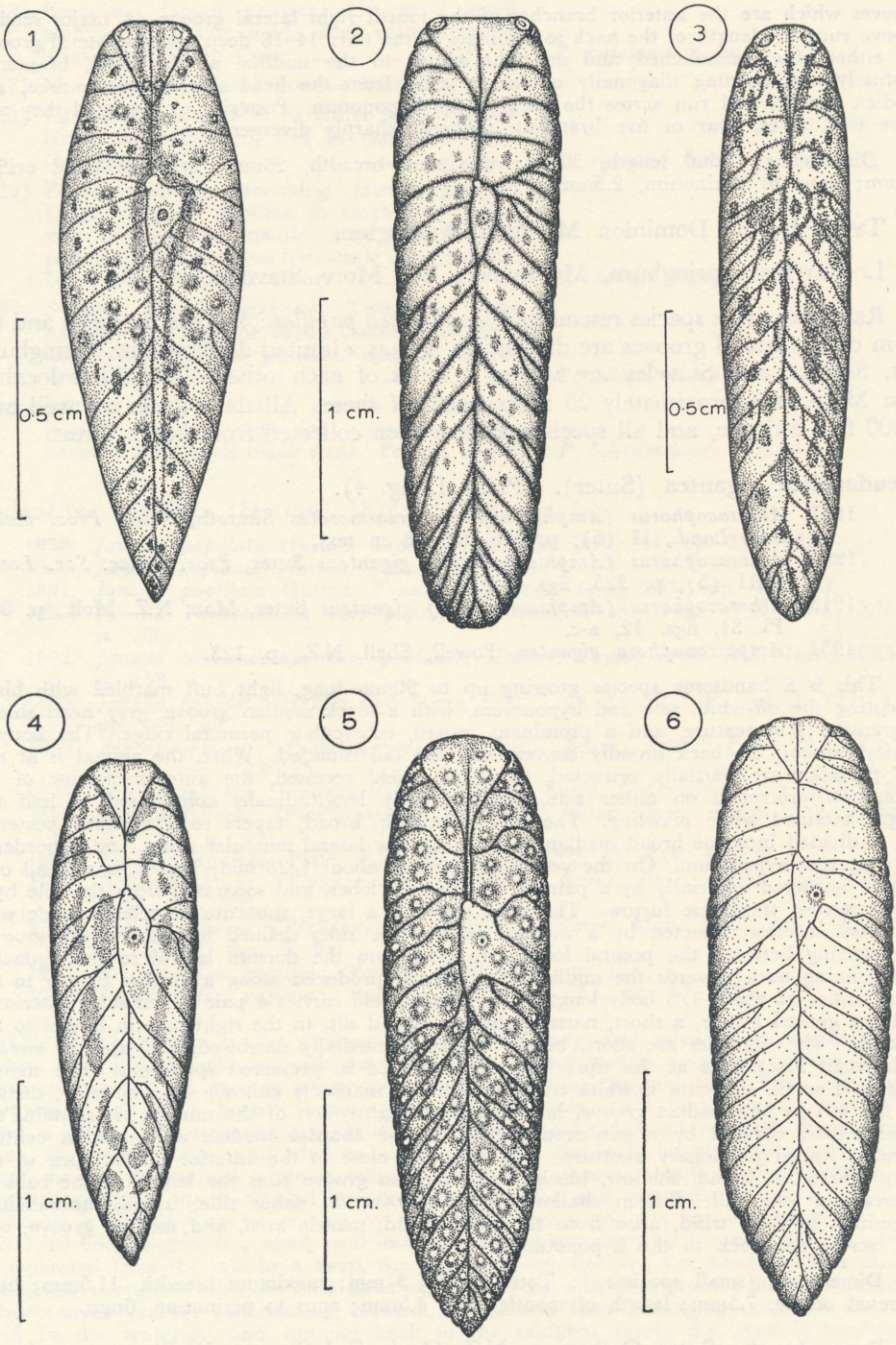
LOCALITIES. Heretaunga, Forty-Mile Bush, Pelorus Valley, Nelson, Greymouth, Little River, Riccarton Bush, Governor's Bay, Hooker Valley, Invercargill (H. Suter), Ashburton (W. W. Smith), Chatham Is. (?) (H. Travers), Pourangaki Riv., Ruahine Ranges, Masterton, Cape Palliser, Wellington, Stokes Valley, Naenae, Akatarawa, Lewis Pass, Geraldine.

REMARKS. This is the largest and one of the commonest species of the Athoracophoridae. It is widely distributed throughout the South Island, but has not been recorded north of the Ruahine Ranges in the North Island. The Chatham Is. reference can only be regarded as doubtful, as Suter states that he did not examine this specimen. In the absence of further evidence, this identification is rather doubtful. The species does not appear to be restricted to one habitat, and has been collected from beech forest, podocarp/mixed hardwood forest, and grassland. It appears to favour a forest habitat, but it can withstand considerably drier conditions than *Athoracophorus bitentaculatus,* which is found only where the rainfall exceeds 50in a year. *P. papillata* resembles both *P. dendyi* and *P. multistriata,* but has a greater number of papillae than the former and fewer grooves than the latter.

Pseudaneitea dendyi Suter (Plate I, fig. 2).

1897. *Athoracophorus (Pseudaneitea) dendyi* Suter, *Proc. malac. Soc. Lond.,* II (6), p. 253, figs. 12–17.
1898. *Janella dendyi,* Plate, *Zool. Jb.* (Anat. und Ontog.), Jena, XI, p. 273.
1909. *Athoracophorus (Pseudaneitea) dendyi,* Suter, *Proc. malac. Soc. Lond.,* VIII (5), p. 324.
1913. *Athoracophorus (Pseudaneitea) dendyi,* Suter, Man. N.Z. Moll., pp. 797–798, Pl. 31, fig. 6.
1937. *Pseudaneitea dendyi,* Powell, Shell. N.Z., p. 123.
1962. *Pseudaneitea dendyi,* Burton, *Tuatara,* p. 88.

This is a handsome, distinctive species growing up to 50mm long, dark grey along the midline, yellowish-grey along the sides excepting the off-white sole and hyponotum, with very obvious white-tipped, raised, rounded tubercles flanking the midline on either side in a single row anterior to the mantle area, double posteriorly, and a smooth or very minutely granulate skin texture. The body is broad, semicylindrical, and tapers from 4/5 body length to a pointed tail. The sole is smooth, tapers to a pointed posterior tip, is divided into one broad median and two narrow lateral muscular zones, and is bordered on either side by a broad hyponotum. A small, oval mouth, on the ventral surface at about 1/20 body length, is bordered anteriorly by a pair of oval preoral lobes, and separated from the sole by a deep, narrow, transverse furrow. The head shield is a moderately sized equilateral triangle with the base anterior, bisected by a median groove, the sides defined by two convex grooves commencing between the preoral lobes, emerging onto the dorsum lateral to the tentacles, and running back towards the midline; the apex is usually produced posteriorly by a narrow furrow to the renal orifice at about 1/4 body length. The head shield carries a pair of tentacles anteriorly, and the genital orifice, a short, narrow, slightly curved slit, in the right margin lateral to the tentacle. The tentacles are up to 4mm long, basally sheathed, medially narrowed, and apically swollen with small black eyes at the tips; they are retracted in preserved specimens. The mantle area is a small, obtuse isosceles triangle, sometimes a quadrilateral, based on the median groove, here displaced slightly left of the midline; it contains the renal orifice, covered by a semicircular lobe, in the anterior median apex, and a central, circular, lipped pulmonary aperture. The anus is close to the perinotum lateral or just anterior to the renal orifice, and bordered by pre- and post-anal



TEXT-FIG. 3

FIG. 1.—*Pseudaneitea maculata.* FIG. 2.—*Pseudaneitea gravisulca.* FIG. 3.—*Pseudaneitea campbellensis.* FIG. 4.—*Athoracophorus suteri.* FIG. 5.—*Reflectopallium papillatum.* FIG. 6.—*Reflectopallium delli.*

grooves which are the anterior branches of the fourth right lateral groove. A major median groove runs the length of the back to bifurcate at the tail: 14–16 deep, narrow lateral grooves on either side, unbranched and at right angles to the midline at the head, branching profusely and running diagonally elsewhere, arise from the head shield, mantle area, and median groove, and run across the back to the hyponotum. Posterior to the head they may have two, three, four or five branches, normally sharply divergent.

Dimensions: Total length, 50mm; maximum breadth, 23mm; head to renal orifice, 16mm; anus to perinotum, 2.5mm.

TYPE. In the Dominion Museum, Wellington.

LOCALITIES. Springburn, Mt. Somers, Ben More, Staveley.

REMARKS. This species resembles *Pseudaneitea papillata,* but the tubercles and the form of the lateral grooves are distinctive. It has a limited distribution: Springburn, Mt. Somers, and Staveley are within 5 miles of each other. The other locality, Ben More, is approximately 25 miles north of these. All these areas are well over 1,000 feet altitude, and all specimens have been collected from beech forest.

Pseudaneitea gigantea (Suter). (Plate I, fig. 4).

1897. *Athoracophorus (Amphikonophora) marmoratus* Simroth, Suter, *Proc. malac. Soc. Lond.,* II (6), p. 256, fig. 18 in text.
1909. *Athoracophorus (Amphiconophora) giganteus* Suter, *Proc. malac. Soc. Lond.,* VIII (5), p. 325, figs. 4–7.
1913. *Athoracophorus (Amphiconophora) giganteus* Suter, Man. N.Z. Moll., p. 805, Pl. 31, figs. 12, a-c.
1937. *Amphiconophora gigantea,* Powell, Shell. N.Z., p. 123.

This is a handsome species growing up to 90mm long, light buff marbled with black excepting the off-white sole and hyponotum, with a black median groove, grey head shield, a granular skin texture, and a prominent, raised, tuberculate perinotal ridge. The body is semicylindrical, the back broadly convex, and the tail rounded. When the animal is at rest the tentacles are partially retracted, the head shield recessed, the anterior portion of the perinotum protruded on either side, and the body longitudinally compressed to half the length attained while crawling. The sole is smooth, broad, tapers to a rounded posterior tip, is divided into one broad median and two narrow lateral muscular zones, and is bordered by a narrow hyponotum. On the ventral surface, at about 1/20 body length, is a small oval mouth, bordered anteriorly by a pair of oval preoral lobes, and separated from the sole by a deep, narrow, transverse furrow. The head shield is a large, subacute isosceles triangle with the base anterior, bisected by a median groove, the sides defined by two convex grooves commencing between the preoral lobes, emerging onto the dorsum lateral to the tentacles, and running back towards the midline; the apex is produced along a narrow furrow to the renal orifice at about 1/5 body length. The head shield carries a pair of tentacles anteriorly, and the genital orifice, a short, narrow, slightly curved slit, in the right margin lateral to the tentacle. The tentacles are short, basally sheathed, medially narrowed, and apically swollen with small black eyes at the tips; they are retracted in preserved specimens. The mantle area is a small, subacute isosceles triangle with the markedly concave base anterior, defined on the left by the median groove, here displaced slightly left of the midline; it contains the renal orifice, covered by a semicircular lobe, in the anterior median apex, and a central, circular, lipped pulmonary aperture. The anus lies close to the anterior lateral apex of the mantle area. A broad, shallow, black, major median groove runs the length of the back to bifurcate at the tail. Fifteen shallow lateral grooves on either side, usually unbranched, sometimes bifid or trifid, arise from the head shield, mantle area, and median groove, and run across the back to the hyponotum.

Dimensions (small specimen): Total length, 31mm; maximum breadth, 11.5mm; head to renal orifice, 7.5mm; length of mantle area, 4.5mm; anus to perinotum, 6mm.

TYPE. In the Suter Collection, N.Z. Geological Survey, Wellington.

LOCALITIES. Collingwood (Suter), Chausille Ridge, S. Westland (H. Newton), Homer Tunnel (J. Salmon), Te Anau (G. Ramsay), Greymouth (J. Jackson).

REMARKS. This interesting species was first described by Suter in 1897. He was under the mistaken impression that it had already been described by Simroth in 1889

as *Athoracophorus marmoratus*. By 1909 Suter had realised his mistake, and formulated a new species, *Athoracophorus giganteus*. However, he still included the species in the subgenus *Amphiconophora,* and this classification was retained when the subgenus was raised to generic status by Powell in 1937. However, detailed study of the species does not reveal any valid reason for including it in this genus. The diagnostic characters of the species agree in all respects with the diagnosis put forward for the genus *Pseudaneitea* by Cockerell in 1891. Furthermore, the nature of the accessory glands of the reproductive system of *Pseudaneitea gigantea* is markedly different from those of *Palliopodex verrucosus,* the other member of the genus *Amphiconophora.* In fact, *P. gigantea* closely resembles other Pseudaneiteids in the structure of its reproductive organs, although it does retain some individual features such as the straight hermaphrodite duct. The position of the anus is not really relevant; *P. gigantea* merely has a slightly shorter rectum than most members of the genus. The position of the anus is subject to individual variation, and the anus in some specimens may be situated midway between the perinotum and the outer angle of the mantle area. Furthermore, *Palliopodex verrucosus* has the anus enclosed within the mantle area. It is obvious that these two species are not closely related.

Pseudaneitea gigantea is found only on the West Coast of the South Island, whereas *Palliopodex verrucosus* inhabits the Auckland Islands. If the two species were closely related, it is likely that this would be more strongly reflected in their distribution.

Pseudaneitea gigantea has been collected only from Beech forest.

Pseudaneitea maculata n. sp. (Plate III, fig. 1).

This small, rather insignificant species, known from only one specimen 14.5mm long, is mid-brown excepting the yellowish-white sole and hyponotum and yellowish-brown mantle area, with numerous irregular black spots, a longitudinal black streak anterior to the mantle area, and small, hemispherical papillae near the midline. The body is cylindrical with the head narrow, and tapers to a pointed tail. The sole is smooth, broad medially, tapers to a pointed posterior tip, is divided into one broad median and two narrow lateral muscular zones, and is bordered on either side by a broad hyponotum. The small, oval mouth, on the ventral surface at about 1/20 body length, is bordered anteriorly by two oval preoral lobes, and separated from the sole by a deep, narrow, transverse furrow. The head shield is a small equilateral triangle with the base anterior, bisected by a median groove, the sides defined by two convex grooves commencing between the preoral lobes, emerging onto the dorsum lateral to the tentacles, and running straight back to the midline. A pair of tentacles are carried anteriorly on the head shield, and the genital orifice, a short, narrow, slightly curved slit, is in the right margin lateral to the tentacle. The mantle area is a small, subacute isosceles triangle with the concave base anterior, defined on the left by the median groove, here displaced slightly left of the midline, and on the right by a cusped groove giving rise to three lateral grooves; it contains a renal orifice, covered by an oblique oval lobe, in the anterior median apex, and a central, circular, lipped pulmonary aperture. The anus is close to the perinotum, lateral to the renal orifice, and is bordered by pre- and post-anal grooves which are the anterior branches of the fourth right lateral groove. A major median groove runs the length of the back to bifurcate at the tail. Fourteen narrow, unbranched lateral grooves on the right and 15 on the left arise from the head shield, mantle area, and median groove and run across the back to the hyponotum. Anterior to the mantle area they run at right angles to the midline; all others run diagonally.

Dimensions: Total length, 14.5mm; maximum breadth, 4.5mm; head to renal orifice, 4mm; length of mantle area, 2mm; anus to perinotum, 0.5mm.

TYPE. In the Dominion Museum, Wellington.

LOCALITY. Ship Cove, Queen Charlotte Sound.

REMARKS. As the specimen described had been preserved since 1949, the mid-brown background colour cited is probably not the original colour. However, the

black spots on the back, to which the specific name refers, are distinctive. The habitat of the species is low bush and scrub.

Pseudaneitea gravisulca n. sp. (Plate III, fig. 2).

This is a small, distinctive species known from one specimen 25mm long, light buff excepting the off-white sole and hyponotum, with irregular, longitudinally arranged black spots, a minutely papillate skin, a complete lack of large papillae, and very deep grooves. The body is semicylindrical, the back broadly convex, and the tail rounded. The sole is smooth, broad, rounded posteriorly, divided into one broad median and two narrow lateral muscular zones, and bordered on either side by a narrow hyponotum. On the ventral surface, at about 1/20 body length, is a small oval mouth, bordered anteriorly by two oval preoral lobes and separated from the sole by a deep, narrow, transverse furrow. The head shield is moderate in size, equilaterally triangular with the base anterior, bisected by a median groove, the sides defined by two deep grooves commencing between the preoral lobes, emerging onto the dorsum lateral to the tentacles, and running back to the midline: it carries a pair of tentacles anteriorly, and the genital orifice, a short, narrow, slightly curved slit, in the right margin lateral to the tentacle. The mantle area is a small, acute isosceles triangle with the base anterior, defined on the left by the median groove, here displaced slightly left of the midline. The mantle area contains a lobed renal orifice in the anterior median apex, and a central, circular, lipped pulmonary aperture. The anus is close to the perinotum, lateral to the renal orifice, and is bordered by pre- and post-anal grooves which are the branches of the anterior bifurcation of the fifth right lateral groove. A major median groove runs the length of the back to bifurcate at the tail. Seventeen narrow, very deep lateral grooves on either side, unbranched at head and tail, usually bifid elsewhere, and trifid just posterior to the mantle area, arise from the head shield, mantle area, and median groove, and run diagonally across the back to the hyponotum. Any branching occurs close to the perinotum, the branches diverging gradually.

Dimensions: Total length, 25mm; head to renal orifice, 6.5mm; maximum breadth, 7mm; length of mantle area, 3mm; anus to perinotum, 1mm.

TYPE. In the Dominion Museum, Wellington.

LOCALITY. Picton.

REMARKS. This species is unusual, for though the skin of the dorsum is thick, there is no trace of large papillae. Other members of the genus have papillae which may be retracted, but even in this state the positions of the papillae can be seen. The other two members of the genus with no large papillae both have relatively thin skin.

The habitat and range of the species are not known.

Pseudaneitea schauinslandi (Plate) (Plate I, fig. 7).

1897. *Janella schauinslandi* Plate, *SB. Ges. naturf. Freunde Berlin,* p. 141.
1898. *Janella schauinslandi* Plate, *Zool. Jb.* (Anat. und Ontog.), Jena, XI, pp. 193–269, Pls. 12–17.
1909. *Athoracophorus (Pseudaneitea) schauinslandi,* Suter, *Proc. malac. Soc. Lond.,* VIII (5), p. 325, Pl. IX, fig. 6.
1913. *Athoracophorus (Pseudaneitea) schauinslandi,* Suter, Man. N.Z. Moll., p. 803, Pl. 31, fig. 10.
1937. *Pseudaneitea schauinslandi,* Powell, *Shell. N.Z.,* p. 123.
1962. *Pseudaneitea schauinslandi,* Burton, *Tuatara,* 9 (3), p. 88.

This is a handsome species growing up to 44mm long, light yellowish-brown excepting the off-white sole, with very numerous minute, black-tipped papillae on the dorsum and two to four large rounded papillae in each side field. The body is relatively broad, semi-cylindrical, and tapers to a pointed tail. The sole is smooth, narrow, tapers to a pointed posterior tip, is divided into one broad median and two narrow lateral muscular zones, and is bordered on either side by a broad hyponotum. On the ventral surface at about 1/20 body length is a small, oval mouth, bordered anteriorly by a pair of oval preoral lobes, and separated from the sole by a deep, narrow, transverse furrow. The head shield is small, equilaterally triangular with the base anterior, bisected by a median groove, the sides defined by two convex grooves commencing between the preoral lobes, emerging onto the dorsum lateral to the tentacles, and running back towards the midline; the apex is produced posteriorly

to the renal orifice at 1/4 body length. The head shield carries a pair of tentacles anteriorly, and the genital orifice, a short, narrow, slightly curved slit, in the right margin lateral to the tentacle. The tentacles are short, basally sheathed, slightly narrowed medially, rounded and slightly expanded distally with a small black eye at the tip. The mantle area is a small, obtuse isosceles triangle based on the median groove, here displaced slightly left of the midline, occupying about 1/6 body length. It contains the renal orifice, covered by a circular lobe, in the anterior apex, and a central, circular, lipped pulmonary aperture. The anus is close to the perinotum lateral to the renal orifice, and is bordered by pre- and post-anal grooves which are the anterior branches of the trifid fourth right lateral groove. A major median groove runs the length of the back; 15 broad, shallow lateral grooves on either side, nearly all bifid or trifid, arise from the head shield, mantle area, and median groove, and run diagonally across the back to the hyponotum.

Dimensions: Length, 45mm; breadth, 11mm; head to renal orifice, 10.5mm; length of mantle area, 7mm; anus to perinotum, 2mm.

TYPE. In the Museum fur Naturkunde, Bremen.

LOCALITIES. Stephens Island (type), Manaroa, Crail Bay.

REMARKS. The species was first described by Plate in 1897. He stated that there was no median groove on the head shield, but this error was corrected by Suter in 1913. Probably Plate's specimens had been preserved for some time, in which case the groove would be very difficult to see, especially as the grooves in this species are rather shallow. The tentacles in this species may be retracted until their position is revealed only by small depressions in the skin, and by the coloration. However, when the animal is preserved the papillae are obvious.

P. schauinslandi has been found only at Stephens Is., Manaroa, and Crail Bay. This argues a lack of collectors rather than a scarcity of animals. The habitat of the Stephens Island specimens is not stated; the Manaroa and Crail Bay specimens were found in podocarp/mixed hardwood bush.

There are some differences in proportion between Plate's drawing, Suter's drawing, and the Manaroa and Crail Bay specimens. This should not be regarded as significant, as much depends on the method of narcotisation and the degree of relaxation of the specimen.

Pseudaneitea multistriata n. sp. (Plate I, fig. 3).

This distinctive species grows up to 55mm long, is greyish black excepting the yellowish off-white sole and hyponotum, with very numerous obvious conical papillae ranging up to 2mm in diameter and numbering up to 5 in each side field, a prominent tuberculate perinotal ridge, and a finely granulate skin texture. The body is cylindrical and broad anteriorly, and tapers to a pointed tail; all preserved specimens are curved with the back convex. The sole is smooth, broad anteriorly, tapers to a pointed posterior tip, is divided into one broad median and two narrow lateral muscular zones, and is bordered on either side by a narrow hyponotum. The small, oval mouth, on the ventral surface at about 1/20 body length, is bordered anteriorly by a pair of oval preoral lobes and separated from the sole by a deep, narrow, transverse furrow. The head shield is a moderately-sized equilateral triangle with the base anterior, bisected by a mdian groove, the sides defined by two convex grooves commencing between the preoral lobes, emerging onto the dorsum lateral to the tentacles, and running back towards the midline; the posterior apex is produced by a narrow furrow to the renal orifice at about 1/5 body length. The head shield carries a pair of tentacles anteriorly, and the genital orifice, a short, narrow, slightly curved slit, in the right margin lateral to the tentacle; the tentacles are retracted in preserved specimens. The mantle area is a subacute isosceles triangle based on the concave anterior lateral margin, and defined on the left by the median groove, here displaced slightly left of the midline. It occupies about $\frac{1}{8}$ body length, is $1\frac{1}{2}$ times as long as broad, contains a lobed renal orifice in the anterior lateral apex, and a central, circular, lipped pulmonary aperture. The anus lies midway between the lateral apex of the mantle area and the perinotum, and is bordered by pre- and post-anal grooves, which are the branches of the sixth right lateral groove. A major median groove runs the length of the back to bifurcate at the tail; 22 deep lateral grooves, unbranched at the head and tail, and bifid or trifid elsewhere, arise from the head shield, mantle area, and median groove, and run diagonally across the back to the hyponotum.

Dimensions: Total length, 53mm; maximum breadth, 13mm; length of mantle area, 6.5mm; head to renal orifice, 12mm; anus to perinotum, 3.5mm.

TYPE. Collected Long Island, off Stewart Is., in the Dominion Museum, Wellington.

LOCALITIES. Stewart Island and its offshore islands.

REMARKS. All specimens examined by me were strongly arched, with the back convex. These slugs seem to have stronger foot musculature than the other species. The species most closely resembles *P. papillata,* but differs in having more lateral grooves, more papillae, a strong perinotal ridge, and little tendency towards diminution of size in the papillae. All specimens were found on tree trunks and vegetation at night. This behaviour is normal, as the Athoracophoridae in general are nocturnal, climbing up from the ground at night to feed, commonly on encrusting fungi on leaves.

Pseudaneitea johnsi n. sp. (Plate I, fig. 5).

A small, distinctive species growing up to 30mm long, light brownish-grey excepting the creamy off-white sole and hyponotum, with a prominent black spot covering the posterior apex of the mantle area, a finely granulate skin texture, 2 to 3 large hemispherical papillae in each side field, and a prominent tuberculate perinotal ridge. The body is semicylindrical and tapers to a rounded tail. The sole is smooth, tapers to a rounded posterior tip, is divided into one broad median and two narrow lateral muscular zones, and is bordered on either side by a narrow hyponotum. A small, oval mouth, on the ventral surface at about 1/20 body length, is bordered anteriorly by a pair of oval preoral lobes and separated from the sole by a deep, narrow, transverse furrow. The head shield is a moderate sized equilateral triangle with the base anterior, bisected by a median groove, the sides defined by two convex grooves commencing between the preoral lobes, emerging onto the dorsum lateral to the tentacles, and running back towards the midline; the apex is produced posteriorly along a narrow furrow to the renal orifice at 1/4 body length. The head shield carries a pair of tentacles anteriorly, and the genital orifice, a short, narrow, slightly curved slit, in the right margin lateral to the tentacle. The tentacles are short, basally sheathed, medially narrowed, and apically swollen with small black eyes at the tips; they are retracted in preserved specimens. The mantle area is a small, acute isosceles triangle with the base anterior, defined on the left by the median groove, here displaced slightly left of the midline; it occupies 1/6 body length, is 1¾ times as long as broad, and contains a lobed renal orifice in its anterior apex and a circular, lipped pulmonary aperture, close to the posterior lateral margin. The anus is close to the perinotum lateral to the renal orifice, and bordered by pre- and post-anal grooves which are the branches of the fourth right lateral groove. A major median groove runs the length of the back to bifurcate at the tail; 15–16 deep lateral grooves on either side, unbranched at the tail and bifid or trifid elsewhere, arise from the head shield, mantle area, and median groove and run diagonally across the back to the hyponotum.

Dimensions (type): Length, 30mm; breadth, 7mm; head to renal orifice, 6mm; length of mantle area, 4mm; anus to perinotum, 1mm.

TYPE. Collected Oct., 1960, in the Dominion Museum, Wellington.

LOCALITY. Northwest D'Urville Is.

REMARKS. Judging by the relative development of the reproductive organs, the present specimens are all juvenile, and the species presumably grows to a larger size. However, it is almost certain that there will be no external difference save size between the juveniles examined and the adult slug. In *P. papillata* the external morphology of the newly hatched slug is identical with that of the adult, and the coloration is stable after about three weeks. This is also true of *P. gigantea, Athoracophorus bitentaculatus,* and *P. dendyi,* in all of which juvenile specimens have been examined. Thus the distinctive black spot on the posterior apex of *P. johnsi* can be regarded as a valid specific character. The papillae of *P. johnsi,* like those of *P. schauinslandi* and *P. papillata,* may be retracted until their position is revealed by coloration alone. This, however, is unusual, and the papillae are normally prominently displayed.

All specimens were taken in a valley, in heavy bush.

Pseudaneitea sorenseni Powell. (Plate I, fig. 6).

1955. *Pseudaneitea sorenseni* Powell, *Cape Exped. Ser. Bull.* 15, pp. 128, 129, Pl. 4, fig. 40.

Small slugs growing up to 27mm long, buff except for a black streak along the midline and an irregularly marbled black streak along either side, with a finely granulate skin texture, and 3–4 large hemispherical papillae in each side field. The body is semicylindrical, broad anteriorly, and tapers to a bluntly pointed tail. The sole is smooth, tapers to a pointed posterior tip, is divided into one broad median and two narrow lateral muscular zones, and is bordered by a narrow hyponotum. The head shield is a small, obtuse isosceles triangle with the base anterior, bisected by a median groove, the sides defined by two convex grooves commencing between the preoral lobes, emerging onto the dorsum lateral to the tentacles, and running back towards the midline; the apex is produced posteriorly along a narrow furrow to the renal orifice at about 1/5 body length. The head shield carries a pair of tentacles anteriorly, and the genital orifice, a short, narrow, slightly curved slit, in the right margin lateral to the tentacle. The small, oval mouth, on the ventral surface at about 1/20 body length, is bordered anteriorly by a pair of oval preoral lobes and separated from the sole by a deep, narrow, transverse furrow. The mantle area is a small, subacute isosceles triangle with the concave base anterior, defined on the left by the median groove, here displaced slightly left of the midline. The mantle area contains the lobed renal orifice in the anterior median apex, and a central, circular, lipped pulmonary aperture. The anus is close to the perinotum, lateral to the renal orifice, immediately anterior to the fourth right lateral groove; there is no preanal groove. A major median groove runs the length of the back to bifurcate at the tail. Thirteen to 15 narrow lateral grooves, mostly unbranched, arise from the head shield, mantle area, and median groove, and run diagonally across the back to the hyponotum.

Dimensions (type): Length, 27mm; breadth, 6.5mm; head to renal orifice, 8.5mm; length of mantle area, 2.5mm; anus to perinotum, 1mm.

TYPE. St. Col Peak, Campbell Is., under stones (Cape Exped., J. H. Sorensen, May 29, 1942). Auckland Museum.

LOCALITY. Campbell Island.

REMARKS. This species was originally merged with the Snares Islands species *Pseudaneitea huttoni* by Suter. However, as Powell, 1955, pointed out, Suter had only one specimen of the Campbell Island slug, taken by the 1907 Subantarctic Islands Expedition. *Pseudaneitea sorenseni* and *P. huttoni* are similar in general appearance, but the Campbell Island species differs from *P. huttoni* in having only 13 to 15 lateral grooves as against 18-21, in possessing fewer and stronger papillae, and in lacking a preanal groove. Powell (1955) stated that "Series of specimens taken by J. H. Sorensen at Campbell Island and later a few Snares Islands topotypes from C. A. Fleming's visit show that two species are represented."

The slugs have been found under stones, on the fern *Polystichum vestitum*, and in the bases of *Poa litorosa* tussock. I have found pieces of undigested grass up to 3.5mm long in the rectum of a specimen collected by P. G. Poppleton in 1958, and it appears that the slugs eat fungi associated with the tussock.

In some specimens, the surface of the back is minutely granulate, but no papillae are present. However, in all other characters these slugs are identical with the papillate specimens; the papillae probably disappear during preservation.

Pseudaneitea huttoni Suter, 1909.

1909. *Athoracophorus (Pseudaneitea) huttoni* Suter, The Subantarctic Islands of N.Z., p. 39, Pl. 1, figs. 17–19.
1909. *Athoracophorus (Pseudaneitea) huttoni* Suter, *Proc. malac. Soc. Lond.*, VIII (5), p. 324.
1913. *Athoracophorus (Pseudaneitea) huttoni* Suter, Man. N.Z. Moll., p. 798, Pl. 31, fig. 7.
1937. *Pseudaneitea huttoni*, Powell, *Shell. N.Z.*, p. 123.
1955. *Pseudaneitea huttoni*, Powell, *Cape Exped. Ser. Bull.* 15, p. 128.

At the time of writing, no specimens of this species were available. Therefore a diagnosis only is given.

Diagnosis.

Colour buff, with two rows of black spots flanking the midline on either side. Head shield triangular, extending to mantle area along a narrow furrow. Eighteen-twenty-one lateral grooves, nearly all unbranched, on either side. Back covered with numerous papillae, 4 to 5 in each side field.

TYPE. In the Suter Collection.

REMARKS. The species is similar to *P. sorenseni,* but differs in having 18-21 lateral grooves as against 13-15 in the Campbell Is. species, more and smaller papillae, and a preanal groove. There are colour differences also. Powell (1955) states that " typically the dark marbled colour pattern (in alcohol) resolves into an irregular longitudinal streak on each lateral area, but other specimens are more or less evenly blotched with dark brown on a pale ground. The latter colour-form has the papillae less conspicuous, but the lateral grooves are 18–21 as in the typical form ".

Pseudaneitea campbellensis n. sp. (Pl. III, fig. 3).

This is a small species growing up to 19mm long, dark buff apart from the off-white sole and hyponotum, with irregular black spots over the back, smooth skin, and a total lack of papillae. The body is narrow, semicylindrical, and tapers to a rounded tail. The sole is smooth, narrow, tapers to a rounded posterior tip, is divided into one broad median and two narrow lateral muscular zones, and is bordered by a narrow hyponotum. A small, oval mouth, on the ventral surface at about 1/20 body length, is bordered anteriorly by a pair of oval preoral lobes and separated from the sole by a deep, narrow, transverse furrow. The head shield is a small, subacute isosceles triangle with the base anterior, bisected by a median groove, the sides defined by two convex grooves commencing between the preoral lobes, emerging onto the dorsum lateral to the tentacles, and running back to the midline; it carries a pair of tentacles anteriorly, and the genital orifice, a short, narrow, slightly curved slit, in the right margin lateral to the tentacle. The mantle area is a small, truncated, isosceles triangle based on the median groove, here displaced slightly left of the midline; it contains a lobed renal orifice in the anterior median apex at 1/4 body length, and a central, circular, lipped pulmonary aperture. The anus is close to the lateral margin of the mantle area. A major median groove runs the length of the back to bifurcate at the tail; 17 deep, narrow lateral grooves, usually bifid but unbranched at head and tail, arise from the head shield, mantle area, and median groove, and run diagonally across the back to the hyponotum. Any branching occurs midway along the groove, the branches diverging sharply.

Dimensions: Length, 18.5mm; breadth, 4mm; head to renal orifice, 5mm; length of mantle area, 2mm; anus to perinotum, 3mm.

TYPE. Collected No. 2 Camp Lookout, Campbell Is., by R. L. Oliver, in the Dominion Museum, Wellington.

REMARKS. The position of the anus in this species is similar to that in *P. gigantea,* but the two species differ in numerous respects, such as the shape of the mantle area and the number and branching of the grooves. The skin texture is unusual in a Pseudaneiteid: smooth skin is otherwise found only in the three species of *Athoracophorus.* In this case, however, the skin texture is probably due to contraction of the skin during preservation.

Pseudaneitea powelli n. sp. (Plate II, fig. 7).

This is a small species growing up to 32mm long, mid-grey excepting the off-white sole and hyponotum, with two lines of round, dark grey spots on either side, a very minutely granulate skin texture, and some insignificant, low, rounded papillae often fused into low, rounded ridges. The body is narrow, semicylindrical, and tapers to a bluntly pointed tail. The sole is smooth, broad, tapers to a pointed posterior tip, is divided into one broad median and two narrow lateral muscular zones, and is bordered on either side by a narrow hyponotum. A small, oval mouth, on the ventral surface at about 1/20 body length, is bordered anteriorly

by two oval preoral lobes and separated from the sole by a deep, narrow, transverse furrow. The head shield is a large equilateral triangle with the base anterior, bisected by a median groove, the sides defined by two convex grooves commencing between the preoral lobes, emerging onto the dorsum lateral to the tentacles, and running back towards the midline; the apex is produced posteriorly along a narrow furrow to the renal orifice at 1/5 body length. The head shield carries a pair of tentacles anteriorly, and the genital orifice, a short, narrow, slightly curved slit, in the right margin lateral to the tentacle. The mantle area is a truncated, sub-obtuse isosceles triangle based on the median groove and occupying about $\frac{1}{3}$ body length. It contains the obliquely lobed renal orifice in the anterior median apex, and a central, circular, lipped pulmonary aperture. The anus is close to the perinotum lateral to the renal orifice, and bordered by pre- and post-anal grooves which are the branches of the anterior bifurcation of the fourth right lateral groove. A major median groove runs the length of the back to bifurcate at the tail. Nineteen deep, narrow, usually unbranched lateral grooves arise from the head shield, mantle area, and median groove, and run across the back to the hyponotum. Anterior to the mantle area they run at right angles to the midline, all others run diagonally. Some grooves posterior to the mantle area are bifid.

Dimensions: Total length, 32mm; breadth, 8mm; head to renal orifice, 7.5mm; length of mantle area, 4mm; anus to perinotum, 1mm.

TYPE. Collected by D. D. Jennings, Te Anau, August, 1958, in the Dominion Museum, Wellington.

LOCALITIES. Coronet Peak, Te Anau.

REMARKS

The specimens were all collected from under stones in alpine tussock. Though this is the only mainland species not found in a forest environment, it has no obvious adaptive features for a grassland habitat. The two localities from which the species has been collected are rather far apart, and more collecting is needed before the range of the species may be determined.

Pseudaneitea aspera n. sp. (Plate II, fig. 6).

This species grows up to 40mm long, with a greenish-brown coloration, darker near the midline, merging into greyish brown on the head shield, light grey tentacles, greenish-white hyponotum, offwhite sole, and very numerous, densely packed small, hemispherical, white-tipped papillae covering the back. The body is broad, semicylindrical, and tapers from 7/10 body length to a pointed tail. The sole is smooth, broad anteriorly, divided into one broad median and two narrow lateral muscular zones, and bordered on either side by a broad, distinct hyponotum. The small, oval mouth, on the ventral surface at about 1/20 body length, is bordered anteriorly by two oval preoral lobes and separated from the sole by a deep, narrow, transverse furrow. The head shield is a moderate sized, subacute isosceles triangle with the base anterior, bisected by a median groove, the sides defined by two convex grooves commencing between the preoral lobes, emerging onto the dorsum lateral to the tentacles, and running back towards the midline; the apex is produced posteriorly along a narrow furrow to the renal orifice at about 1/4 body length. The head shield carries a pair of tentacles anteriorly, and the genital orifice, a short, narrow, slightly curved slit, in the right margin lateral to the tentacle. The tentacles are up to 7mm long, basally sheathed, medially narrowed, and apically swollen with small black eyes at the tips. The mantle area is a small, subacute isosceles triangle, based on the slightly convex anterior lateral margin and defined on the left by the median groove. It occupies 1/10 body length, and contains the lobed renal orifice in the anterior median apex, and a circular, lipped pulmonary aperture close to the posterior lateral margin. The anus is close to the perinotum, just anterior to the renal orifice, and immediately posterior to the third right lateral groove. A major median groove, not very distinct on the head shield, runs the length of the back to bifurcate at the tail. Nineteen deep, narrow lateral grooves, nearly all unbranched, arise from the head shield, mantle area, and median groove, and run diagonally across the back to the hyponotum.

Dimensions: Length, 38mm; breadth, 10mm; head to renal orifice, 10mm; length of mantle area, 4mm; anus to perinotum, 0.5mm.

TYPE. Collected upper Mason River valley, P. M. Johns, May, 1960, in the Dominion Museum, Wellington.

LOCALITY. Upper Mason River valley.

Remarks

All specimens were found in beech forest. More collecting is required before the range of the species may be determined.

Pseudaneitea simrothi Suter, 1896.

1896. *Athoracophorus (Pseudaneitea) simrothi* Suter, *Proc. malac. Soc. Lond.*, II, p. 34, Pl. 4, figs. 3, 4.
1898. *Janella simrothi*, Plate *Zool. Jb.* (Anat. und Ontog.), Jena, p. 273.
1909. *Athoracophorus (Pseudaneitea) simrothi* Suter, *Proc. malac. Soc. Lond.*, VIII (5), p. 325.
1913. *Athoracophorus (Pseudaneitea) simrothi* Suter, Man. N.Z. Moll., p. 804, Pl. 31, fig. 11.
1937. *Pseudaneitea simrothi*, Powell, Shell. N.Z., p. 123.

No specimens of this species are available. Therefore a diagnosis only is given.

Diagnosis

Colour dull brownish-yellow, the papillae lighter. Head shield triangular, not extending to mantle area. Papillae very large, oval, rounded, crowded, 3–4 in each side field. Fifteen lateral grooves on either side.

Type. In the Suter Collection, Geological Survey, Wellington.

Locality. Collingwood.

Remarks

Suter described this interesting species from a single specimen, and was unable to find any more examples. Plate, in 1898, put forward the opinion that Suter's specimen was merely a juvenile example of *P. papillata* or *P. schauinslandi*. Suter did not agree with this, and stated that the large, oval, crowded papillae were distinctive. As Collingwood is well outside the known range of *P. schauinslandi*, and as the papillae in juvenile specimens of *P. papillata* are quite small and diminish in size towards the perinotum, *P. simrothi* may be regarded as a valid species.

Discussion

There are four genera and twenty-two species now included in the New Zealand and subantarctic Athoracophoridae, all of them classified on external features alone. The principal characters used to differentiate genera are the shape of the mantle area and the position of the anus relative to it, and though these characters appear at first sight to be superficial, a study of the genera erected on this basis reveals other differences between them. The genus *Athoracophorus* forms a unified group quite different from the other three genera; its constituent species possess only 10–15 lateral grooves, have a thinner skin, a general lack of papillae, and a head shield with no posterior median furrow. The genera *Pseudaneitea* and *Reflectopallium* do show some similarities in external form. The other genus, *Palliopodex*, differs markedly from all the above genera in the form of its reproductive system, and appears to be rather separate in character. For differentiation at the species level, other characters may be used. These include the number and form of the lateral grooves, skin texture, number and form of papillae (if any), presence or absence of anal grooves, shape of the head shield, and position of the anus. Colour may also be taken into account, but in some species, notably *Athoracophorus bitentaculatus*, it is rather variable, and too much reliance on it in the past has led to the erection of new species and subspecies which have later proved invalid. However, in other species, notably *Athoracophorus maculosus* n. sp., a distinctive, constant colour pattern is invaluable in the identification of poorly preserved specimens.

Radula characters proved useless for generic or specific differentiation. In any given species, characters such as the number of rows of teeth and the number of

teeth in each row varied considerably. In *Pseudaneitea papillata,* for which Suter gave the denticle number per tooth as 7, radulae taken from three slugs collected at the same time and place had denticle numbers varying randomly between 3 and 11, 4 and 9, and 5 and 9. With such obvious variation as this it is surprising that denticle numbers were used as systematic criteria in the first place.

The genus *Athoracophorus* is found only on the mainland; it has a more northern distribution than the other three genera. The skin of the three constituent species of this genus is thin, and the back has to be kept moister than that of an individual of any other genus. This feature possibly enables the members of the genus to survive in areas with a relatively high average temperature, but they seem to be restricted to areas with over 40in annual rainfall. Furthermore, no member of this genus has yet been found in an open environment, in which the temperature range would be greater and the humidity lower than in forest. The thicker skin of the other three genera apparently enables them to withstand desiccation more easily, and there are numerous records of members of these genera from a grassland habitat.

There are, unfortunately, insufficient records to provide a comprehensive picture of the distribution of the species within New Zealand. There are some widespread species such as *Athoracophorus bitentaculatus, Pseudaneitea papillata,* and *Pseudaneitea gigantea* (West Coast, South Island), but most others appear to have a limited range, for example *Pseudaneitea dendyi,* Mid-Canterbury, *P. schauinslandi,* Marlborough Sounds, *P. powelli,* Queenstown and Te Anau, *Athoracophorus maculosus,* N.W. Nelson, and *Reflectopallium pseudophyllum,* Hawdon River. In fact, apart from a few species, the New Zealand Athoracophoridae show marked geographic speciation, and many hitherto neglected areas probably harbour new species.

The problems posed by the distribution of the subantarctic species are interesting. No subantarctic species has been found on the mainland, and only one species, *Reflectopallium martensi,* occurs on more than one island. This species has been found on both Auckland Is. and Macquarie Is. It is not known how long the slugs have been on the islands, but to speciate as much as they have they must have been there through the Pleistocene glaciation. It appears that the ice cover on the islands was not complete, and small, tussock frequenting species would probably survive so long as there was a continuity of land surface. Large slugs have been found above the bush-line at an altitude of 5,500ft in the South Island, and it does appear that thick-skinned slugs can withstand temperatures down to freezing point. The derivative problem of how the slugs reached the island in the first place cannot be solved on the basis of our present knowledge. While a land bridge hypothesis could be put forward to explain the existence of slugs on Snares, Auckland and Campbell Islands, it fails in the case of Macquarie Is., which is separated from the others by a broad expanse of deep water. Rafting of eggs among masses of drifting vegetation or on floating logs is a possibility; however, an egg immersed in seawater will survive only about three days. As the eggs are often laid in large clusters in cracks in logs, it is possible that a few eggs in the centre of the cluster would survive long enough to drift the necessary distance. But to get to Macquarie Island from Auckland Is., as *Reflectopallium martensi* has done, the raft would either have to drift against the West Wind Drift or complete a circumpolar journey, both of which are most unlikely, to say the least. It is possible that the West Wind Drift is a recent phenomenon, but this possibility is not supported by any evidence. There seems to be no satisfactory solution which can be reached on the basis of our present knowledge.

The most distinctive feature of the group as a whole is the possession of a dorsal tracheate lung of a nature found in no other mollusc. The true function

of this lung remains in doubt. It has been suggested that its function is primarily secretory, but no critical experiments have been carried out to confirm this. On the other hand, there is no direct evidence that the organ functions effectively as a lung. However, the structure of the lung itself is significant. It consists of an expanded pulmonary chamber, its floor and walls lined with muscle tissue, connected by several passages through the muscle with numerous, fingerlike, thin-walled diverticula which radiate out to form the roof of the pulmonary sinus. The floor and walls of the pulmonary chamber are capable of contraction, thus effecting air exchange. Detailed cytological studies by Plate in 1898 and further studies by the author reveal no secretory cells in the lung, though there are numerous glandular cells in the skin around the pulmonary aperture. Detailed experiments are needed before the effectiveness of the lung in respiration can be ascertained.

The presence of this lung is the main diagnostic character for the Family Athoracophoridae, which is found in the Admiralty Is., New Britain, New Hebrides, New Caledonia, the east coast of Australia, New Zealand, and the subantarctic islands. However, the northern slugs show significant differences from the New Zealand and subantarctic slugs. Solem, 1959, states that the New Hebridean slugs show a tendency towards grouping of the external orifices, a reduced or absent central radula tooth, and a reduction in the slime producing organs. By analogy with other groups, he concludes that these features show that the northern Athoracophoridae are more advanced than the southern forms, and thus argues that the group arose in the north and spread south.

Acknowledgments

I am indebted to Professor H. B. Fell, Professor L. R. Richardson, and Dr P. M. Ralph for their advice throughout this study. Mr P. M. Johns, of the Canterbury University Zoology Department, has collected much valuable material. I wish to thank the Dominion Museum, through Dr R. K. Dell, and the Canterbury Museum, through Mr E. G. Turbott, for making available their extensive collections of New Zealand and subantarctic Athoracophoridae.

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